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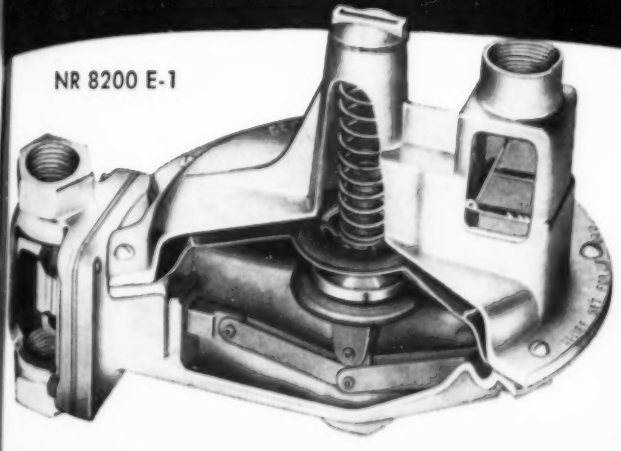

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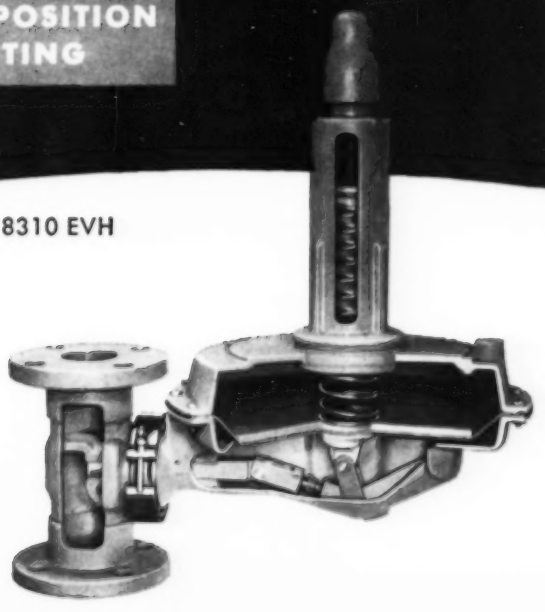

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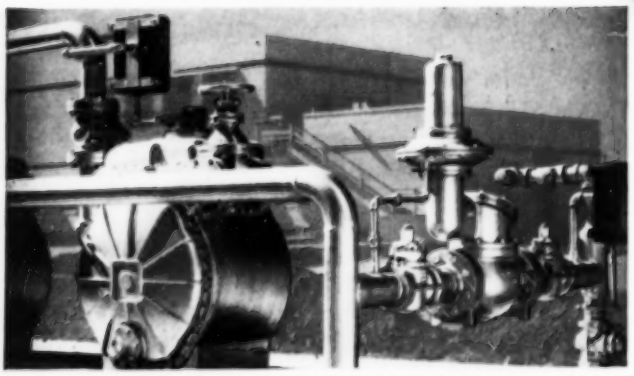

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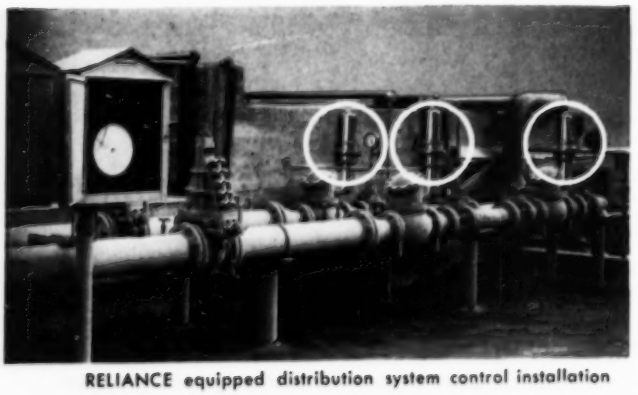

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GAS

31ST YEAR OF PUBLICATION

IN THIS ISSUE . . . .

This is the month when the AGA and PCGA meet in joint session in Los Angeles, and the emphasis in this issue is heavy on the theme of natural gas for the Pacific Northwest. In the distribution section, the market and the distribution companies are treated at length, and in the Pipeline Section the engineering, design, and organizational phases of the transmission portion of the project are covered.

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When the contract calls for it

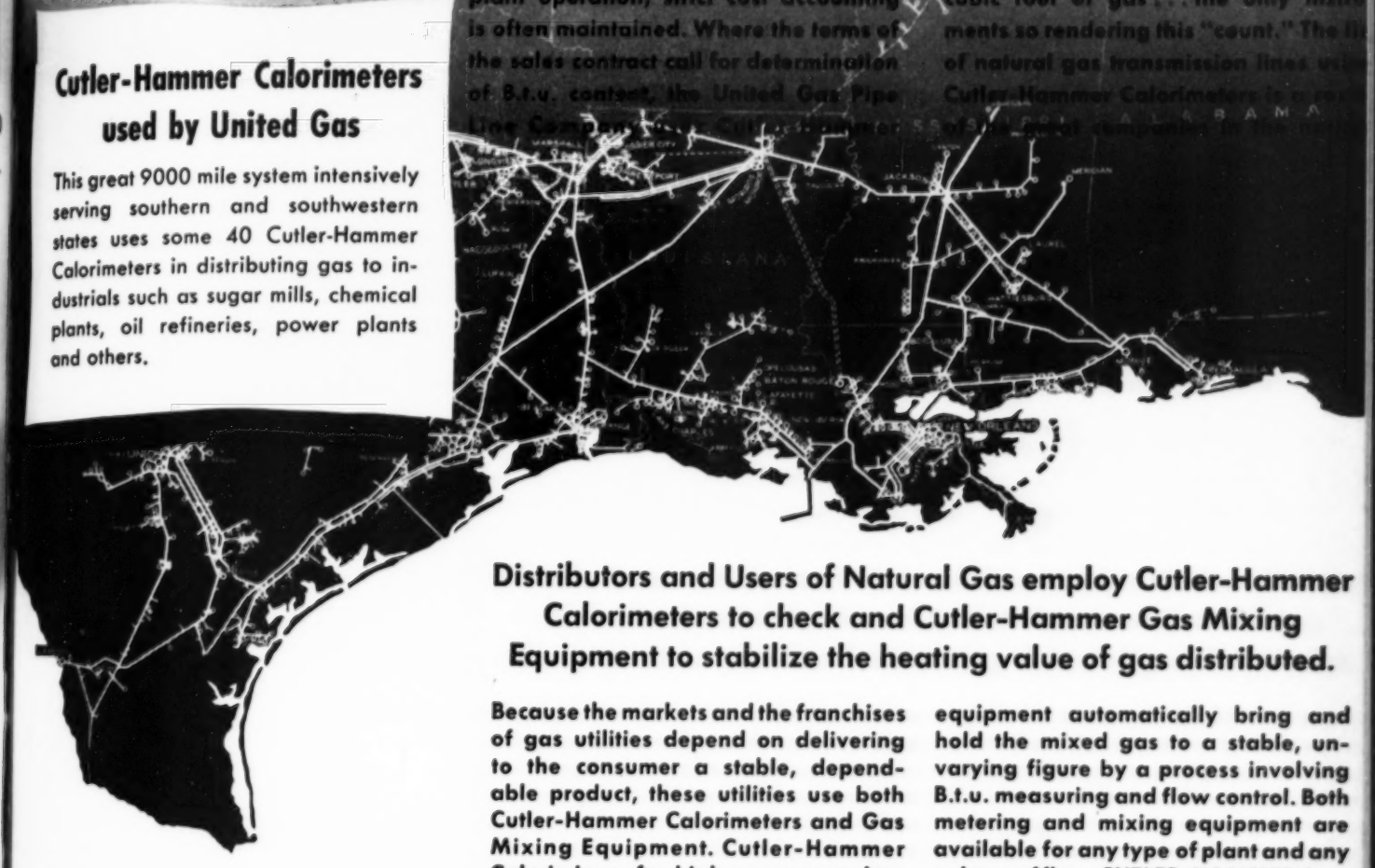
United Gas uses C-H Calorimeters to determine B.t.u. conten of natural gas sold to industrials

UNITED GAS

In many industrial operations, the heating value of gas used in such operations must be carefully stabilized and controlled. In other cases such as power plant operation, strict cost accounting is often maintained. Where the terms of the sales contract call for determination of B.t.u. content, the United Gas Pipe Line Company [illegible] Calorimeters to "count" the B.t.u.'s o natural gas sold to industrials. Cutler Hammer Calorimeters establish accu rately the B.t.u. "count" per standar cubic foot of gas . . . the only instru ments so rendering this "count." The li of natural gas transmission lines usi Cutler-Hammer Calorimeters is a co of 30 [illegible] companies in the

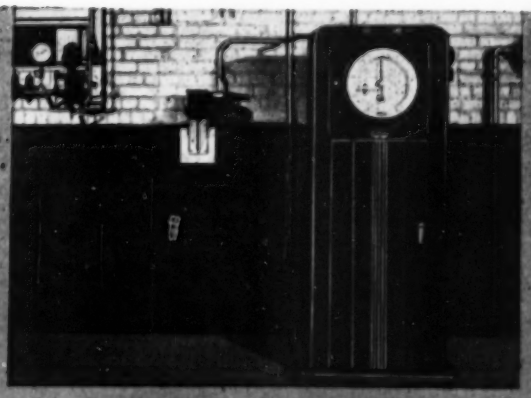
Cutler-Hammer Calorimeters used by United Gas

This great 9000 mile system intensively serving southern and southwestern states uses some 40 Cutler-Hammer Calorimeters in distributing gas to industrials such as sugar mills, chemical plants, oil refineries, power plants and others.



Distributors and Users of Natural Gas employ Cutler-Hammer Calorimeters to check and Cutler-Hammer Gas Mixing Equipment to stabilize the heating value of gas distributed.

Because the markets and the franchises of gas utilities depend on delivering to the consumer a stable, dependable product, these utilities use both Cutler-Hammer Calorimeters and Gas Mixing Equipment. Cutler-Hammer Calorimixers for high pressure or low pressure gas, and Jet-type mixing equipment automatically bring and hold the mixed gas to a stable, unvarying figure by a process involving B.t.u. measuring and flow control. Both metering and mixing equipment are available for any type of plant and any volume of flow. CUTLER-HAMMER, Inc., 1468 St. Paul Ave., Milwaukee 1, Wis.



C-H Calorimeters *(at left)* measure accurately and uncompromisingly the B.t.u. content of each standard unit volume of gas distributed regardless of temperature, pressure or flow variables, and write a continuous, available record.

C-H Calorimixers *(in center)* automatically mix two or more high or low pressure gases of variable heating value in any volume, holding the final product undeviatingly to a stipulated figure.

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C-H Jet type mixers *(at right)* automatically mix gases of different heating values to a final low pressure stabilized value. When mixing directly into gas mains as well as into holders, they automatically adjust production to widely varying demands.

GAS Thermally Thinking

Our pride is showing

WE'RE more than passing proud this month for several reasons. First of all, as should be plainly obvious, this is the largest GAS in history. We thought last year that our October issue was about the biggest that had ever happened—214 pages, to be exact. Sounds a little anemic at this point.

We're more proud than that, though, of the coverage Managing Editor Ebdon gave to the Pacific Northwest story. We're willing to bet that this is the most complete story yet written on the many facets of a pipeline's invasion of a new territory. The market, the distributing companies, the design and construction of the pipeline, the organizing of the pipeline company itself—all these phases go together to make up one of the most fascinating gas stories of this or any other year.

The speed with which Fish Northwest Constructors, agents acting for Pacific Northwest, have gotten into gear on the construction program this summer has been breathtaking. Here is a company whose principal officers are experienced in handling top-speed engineering and construction jobs and the way they have gone ahead on this project reflects this background. Just keeping up with new developments as the summer's and early fall's work progressed has been a taxing chore for the author.

No feet-on-the-desk type editor, he spent rugged days out on the line in remote and well-nigh-inaccessible mountain places where no one but mad dogs, pipeliners, and the hardiest of writers would be foolish enough to venture. Other days were spent in the more comfortable, but ulceriferous, atmosphere of engineers' offices, where a pipeline was being born in record time.

Despite the hazards and discomforts of Utah in July, Fred managed to bring back with him not only a deep admiration for the giants who are building the line but a deep appreciation of the grandeur of the untamed areas of the West as well. With all the difficulties encountered, he still chose to dub this line "The Scenic Inch."

We hope the name sticks. We've had about enough Bigs, Biggers, Toughs and Toughers to keep us for a while. How much bigger can you get than biggest, how much tougher than toughest; and what's superior to super? In these days of easy superlatives, even supreme is meaningless. To me it's just the name on my morning bottle of milk.

So we give you "The Scenic Inch." The story of the year.

• • •

By way of postscript, we are also proud to have the AGA visiting our home town this month. And we're proud that a few people bothered to give us a bravo for last month's remarks about Atlantic City. Since a good share of the membership will be assembled at the convention, it might not be a bad idea for those who agree on the subject to make their desires known. Get vocal, in other words. After all, this is a democracy, we're told.

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LOS ANGELES (57)
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TRENCHING 7 MILES of Indianola Avenue, a heavily traveled thorofare in Columbus, Ohio, called for a fast-moving job. The first step in opening the ditch was to line-cut and break a 7″ course of paving brick topped with asphalt. Two 80 lb. breakers, powered by a Jaeger "125" Roto Air-Plus, were used for this work.

How Jaeger "125" Rotary speeds street work

On the above job, the instant-acting control of the Jaeger rotary, enabling it to maintain 100 lbs. minimum pressure under all air demands up to 125 cfm, made it possible to run two 80 lb. breakers at full efficiency, cutting and breaking an average of 400 linear ft. of 3 ft. wide trench (1200 sq. ft.) each 8 hours.

Because the higher efficiency of the Jaeger Roto enables it to operate at more economical engine speeds, fuel consumption on this job averaged only 1½ gallons an hour.

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highlights

GAS — SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Pacific line construction gathers momentum

Late reports on progress on the big Pacific Northwest line (to which this issue is dedicated) reveal that Schedules 7, 8, 9, and 11 have now been kicked off, leaving only Schedule 10 among the first 11 to get underway. Design engineering on compressor stations is essentially complete; two 2000-hp compressors have arrived for Station 1. Four river crossing contracts have been let, one to Fulton for the Colorado river span near Moab, Utah, and three on the Green river in Utah to River Construction—one near Jensen and two near Manila. At presstime, contracts for two Snake river and one Columbia river crossing were expected to be let momentarily.

Construction, by the way, is back on the elevator again

Early-year conservation on building budgets has completely given way to unbridled optimism in the face of the year's performance to date. Public utilities will be in the vanguard among heavy spenders in a final quarter that the Department of Commerce expects will bring 1955 within a hair's breadth of tying 1953's all-time mark. At the moment, it appears that utilities will spend $4445 million as against $4552 million in 1953 and $4219 last year—this despite first and second quarters that were behind last year. The fourth-quarter estimate of $1235 million, when "seasonally adjusted," represents an annual rate of $4680 million.

Construction has to be high, to keep pace with sales

The irresistible upsurge in gas sales pushed revenues to another all-time peak in the fiscal 1954-1955 year, says AGA. For the 12 months ended June 30, total operating revenues totaled over the $4394 million in the same period a year before. Net operating revenues rose from $572 million to $655 million, a 14.5% boost; net income was up 9.3%, from $441 million to $482 million.

We now have 28 million customers

Excluding customers receiving LPG through city mains, the gas utility industry is now serving 28 million users, the AGA report says. That's a 3.7% increase in a year; or, stated another way, a gain of 1 million customers. Of these, 22.6 million are now on natural gas. Sales of gas hit 15,048 million therms, a gain of 6.7%.

FPC finally took the long stride toward wellhead jurisdiction

More than a year after the historic Phillips decision was laid down by the Supreme Court, the Federal Power Commission last month ruled certain sales of gas by Deep South Oil Co., Humble Oil, and Shell subject to its jurisdiction. In this it upheld Presiding Examiner Marsh. But it overturned the ruling of Examiner Simpson in the Dixie Pipe Line Co. case. Simpson had found the sales of 20 producers outside commission jurisdiction. The commission held that neither the fact that only a small portion of the gas produced from the wells crosses the state line nor the fact that it is processed after it leaves the wells is sufficient cause to take it out of the coverage of the Natural Gas Act.

Tennessee PSC has joined the cause of "consumer protection"

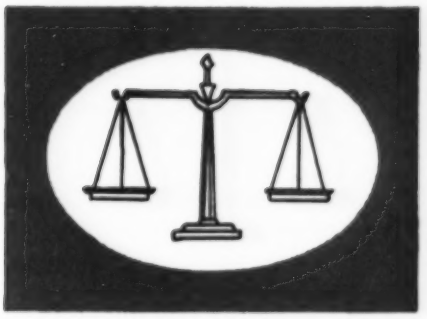
The Tennessee commission has asked FPC to probe rates charged by 16 companies for natural gas sold to Tennessee Gas Transmission Co. One of these producers is Phillips. The petition is in the form of 16 complaints alleging unreasonable producer prices.

"Harris bill is, in effect, a wage cut"—CIO

"Household consumers who heat and cook with gas will be paying, within a few years, $40 a year more for gas in a mild climate like Washington, D. C., and $55 a year more in a climate like Minneapolis. . . . This is like a wage cut of 2 to 2¾ cents per hour." That's the analysis of the Harris bill's results as made by the CIO in a denunciatory flyer recently prepared. The union prepared a complete list of Congressmen, for-and-against, as a guide for its membership in the next elections.

*regulatory and legislative trends

Natural gas producers are halfway to exemption



THE amendment to the Natural Gas Act to exempt producers of natural gas from federal regulation as public utilities passed the House of Representatives by six votes. That close vote indicates the explosive mixture that permeates Congress on this controversial legislation. The Senate will consider the proposed amendment in the 1956 session.

This proposed legislation had a rocky road to the compromise form in which it passed the House. The torrid debate centered on whether the amendment would result in higher gas prices to consumers. Generally, the large gas-producing areas favored the exemption of producers and the big-city consumer areas opposed it. Eighty-six Democrats and 123 Republicans passed the bill over the opposition of 136 Democrats and 67 Republicans. The fate of this legislation in the Senate means much to millions of people, so a resume from the majority and minority reports of the House Committee on Interstate and Foreign Commerce should help management to take enlightened action before the Senate votes.

Majority report

The majority report states that the purposes of the bill H.R. 6645 are: (1) To exempt producers of natural gas from public utility regulation and thus restore the law to what it had been believed generally to be for 16 years prior to the Supreme Court's 1954 decision in the Phillips Petroleum Co. case; (2) To protect consumers from excessive rate increases which might result from the exemption of gas producers; (3) To protect the financial soundness of natural gas pipeline companies by excusing such companies from the obligation, under escalator clauses in existing contracts, to pay an amount in excess of the reasonable market price and to continue the right to receive contracted volumes of gas.

The majority continued by declaring that the public interest does not require regulation of producers as public utilities because competitive conditions make it unnecessary to regulate such producers. The general level of field prices for natural gas has risen over a period of years just as prices have risen generally. It is obvious, however, that competition has kept natural gas prices from "getting out of line."

The natural gas industry has grown phenomenally since the Natural Gas Act was enacted. There is still a large unsatisfied consumer demand in the United States, and consumers are so eager to get this efficient and convenient fuel that little question has been raised about its cost. Natural gas, even after it has been transported thousands of miles, has generally been available to the consumer at a lower cost than competing coal and oil.

The majority pointed out that it is important in considering federal regulation of producers' prices to remember that on the average only about 10% of the price the consumer pays is attributable to the price the gas producer receives.

The majority report quoted the Cabinet Committee's recommendation that protection be provided so that consumers will obtain gas at reasonable rates. According to this report, there is sufficient competition among the thousands of producers of natural gas to insure that it would be exceptional for prices to exceed reasonable levels. To make doubly sure, however, the compromise bill has consumer provisions.

Concerning new or renegotiated gas contracts, the legislation provides that the Federal Power Commission shall not allow the interstate pipeline company to charge as an operating expense more than the reasonable market price of the gas within the vincity of the production area. To remove hardships the bill provides for a prior determination by the commission as to whether the prices to be paid under the contract exceed the reasonable market price.

Concerning escalation clauses in existing gas contracts, the bill recognized the benefits from some and the damage from others. Contracts between producers and interstate pipeline companies are usually long-term contracts, and escalation clauses have provided a means by which producers have been able to avoid accepting a single predetermined price for the entire life of the contract. The principal types of escalation clauses are (1) the two-party favored-nation clause, under which the specified price is increased in the event the purchasing pipeline company pays a higher price to another producer for gas in the same field; (2) the third-party favored-nation clause, which will increase the price if an unrelated third party pays a higher price to another producer for gas in the same field; (3) the "better market" clause, which provides for a price increase in the event the average of the three highest prices paid by pipelines in a given area exceeds the price specified in the contract; (4) the spiral escalator clause, which increases the producer's gas price in the event the resale rates of the pipeline company are increased; (5) the step-up clause, which increases the gas price by specific amounts on periodic future dates; (6) the tax increase clause, which requires the pipeline company to reimburse the producer for increases in taxes.

The bill provides that the pipeline

*A monthly commentary on national and state developments by an expert in the field of utility law.

Regulatory trends... "Reasonable market price" is determined by the commission

company cannot be reimbursed in rates for an increase in the price which it pays producers under any escalation clause, except the "step-up" and "tax increase" clauses, if that price exceeds the reasonable market price for gas. The majority of the House Committee said it would be inequitable under such conditions for the producer to receive more than the reasonable market price if the contract specified a higher price. The legislation continues the producer's obligation to deliver so that the interstate pipeline company will not be denied the gas for which it contracted to meet the requirements of its customers.

The bill provides that if an interstate pipeline company produces gas, it will be allowed the reasonable market price for such gas as an operating expense. This is also the rule where an interstate pipeline company buys gas from an affiliated producer. The majority considered this provision to be an incentive to interstate pipelines to expand their own production and exploration activities. The majority report stated: "The net result of this policy will be better service at lower cost to the consuming public."

The meaning of the term "reasonable market price" becomes highly important. The majority report asserted that the term "reasonable market price" is used because the commission should treat natural gas as a commodity in fixing the rates of pipeline companies "but it should be understood that the reasonable market price is not the price of the latest sale, nor is it the highest price, the weighted highest price, the average field price, or other price arrived at by the mechanical application of a single criterion. Instead, it is a price that the commission, exercising its judgment and discretion in weighing a number of relevant factors, determines is the reasonable market price."

The majority of the committee emphasized that this treatment of natural gas as a commodity is to be distinguished from the original cost rate base approach, which the Federal Power Commission has used in connection with the interstate pipeline company's transportation functions. Thus, the concept of "reasonable market price" differs from that of "just and reasonable rates," which the commission is directed to apply under the Natural Gas Act for making rates that the interstate pipelines charge distributing companies. The majority considered it to be the commission's duty to appraise all of the relevant factors, and it listed the following factors that should be recognized: (1) The quality of the natural gas being purchased; (2) conditions of delivery; (3) the level of prices established currently by generally comparable contracts; (4) prices in different fields and producing areas; (5) whether such prices and the contract price have been established by arm's-length bargaining; and (6) the variation of competitive market prices.

The majority report stated its philosophy succinctly: "The exercise of federal jurisdiction for the purpose of regulating producers of natural gas as public utilities constitutes, it is believed, an extension of federal authority which is without precedent under our American system of free enterprise.

"Producers of natural gas should be treated as what they are, namely, producers of a commodity like coal, oil, or copper, not as public utilities. On this basis they should be exempted as is proposed in this bill."

Minority reports

There were three separate minority reports filed by members of the House committee. One minority report asserted that the amendment to the Natural Gas Act is not in the public interest because the Federal Power Commission's jurisdiction over sales of gas in interstate commerce by independent producers will be scuttled. The report continues by declaring that the other major fallacy in the proposed bill is the usage of the criterion of "reasonable market price" for natural gas. It is a disguised surrender of regulatory control to the producers themselves. What is proposed as regulation becomes an adoption of the very principles of no regulation, which the original Harris Bill openly advocated, declares the minority.

The announced purpose of the amendment is to overcome the recent Supreme Court decision in the Phillips Petroleum case. That decision held the Federal Power Commission to have jurisdiction over the rates charged by gas producers in the field for gas that was transported in interstate commerce. This minority report added that the court case "merely reaffirmed the Congressional intent, which was to close the so-called gap or hiatus in regulation that existed between the inability of states to regulate any sales in interstate commerce and the lack of a federal law."

This proposed legislation reopens that gap and places consumers at the mercy of unregulated producers, proclaimed the minority report.

One minority report stated that: "The testimony presented in hearings shows that there has been an increase of about 100% for gas purchased from producers in the field. It also shows that in many areas of the United States gas has reached a price level where it is in competition with other fuels for industrial and space-heating business. No further increases are possible without loss of business. Thus, any price increase to distributing companies must be added to the residential and house-heating customers which are in competion with oil and electricity since the industrial load factor decline will result in new-cost allocations and these rates will be increased accordingly. Therefore, regulation of the rate charged at the wellhead is a *sine qua non* for adequate protection of consumers.

"The other main amendment to the act requires the Federal Power Commission to determine that only the 'reasonable market price' is paid producers in the field and also allows the 'reasonable market price' for gas which a pipeline produces itself or purchases from an affiliate. This is effectively no regulation at all since FPC will not only be giving the highest price obtainable to a producer but also will permit pipeline companies to 'write up' their owned reserves to an exorbitant level. The usage of this 'field price' will result in millions of dollars being charged the ratepayers."

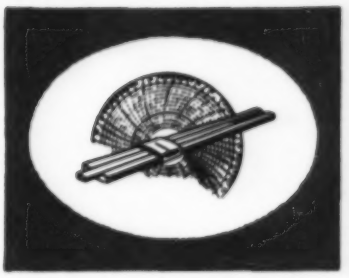
Another minority report was concerned with the cost to consumers and it stated: "We come next to the testimony of consumer witnesses on what the enactment of H.R. 6645 can mean to the consuming public.

"To state their case compactly, it is alleged —

"1. That the oil industry (which controls the great bulk of all natural gas) aims to raise gas prices to the point where they will be competitive on a fuel basis with the costs of coal. This could

(Continued on page 139)

technical trends



• By GUY CORFIELD

Coal pipeline

What is said to be the first coal pipeline is planned for construction this fall by Pittsburgh Consolidated Coal Co. It will run from this company's Georgetown mines in eastern Ohio, to the Cleveland Electric Illuminating Co.'s Eastlake power plant in northeast Cleveland.

This pipeline will be 10 in. in diameter and 108 miles long and estimated to cost between $9 and $10 million. The coal will be powdered and mixed with water to form a slurry, which will be de-watered at the Cleveland end before use in the boiler plant. It is expected to have a capacity of 1.2 million tons of coal per year or 3288 tons per day. This daily tonnage, on a before-use heating value basis, is equivalent to approximately 100 MMcf of natural gas.

The economics, which have no doubt been well worked out, must be quite interesting. Offhand it would seem that a significant proportion of the heat value of the coal must be used to remove the water portion of the slurry. However, assuming the slurry were 50% water by weight, it would require only some 3 billion Btu, or 110 tons of coal, or 3% of the heat value transmitted, to remove the water.

A new use for gilsonite

Gilsonite is a naturally occurring solid asphaltic material. The principal deposit, at Bonanza, Utah, has been known and used since 1904. Gas industry engineers are most familiar with it as a base for "cut back" black asphalt paints and primers, and as an ingredient of some asphalt enamel underground pipe coatings to which it imparts certain stabilizing properties.

It has recently been announced that American Gilsonite, owned jointly by Barber Oil Corp. and Standard Oil Co. of Calif., is spending $10 million to develop hydraulic mining machinery, build a pipeline for transport, and construct a plant for treatment of an initial 600-700 tons of gilsonite per day. The 8-in., 100-mile pipeline will convey the powdered gilsonite in water-slurry form, at the end of which it will be dried and fed to the plant.

Products will be essentially high-grade electrode carbon (in demand for production of aluminum) and gasoline of aviation octane rating. By-product gas will be used as plant fuel. The process is essentially one of fractionation and catalytic reforming.

Plastic-to-metal laminate

Some plastics manufacturers are hailing as a new industry the bonding of vinyl sheets to steel, aluminum, etc., to form a laminated material with the corrosion resistance and color and attractive surface of plastic, and the strength of metal. The process, which is under the licensing control of U. S. Rubber's Naugatuck Chemical Co., with the name of "Marvibond," is carried out essentially as follows: preparing the metal sheet by cleaning, application of an adhesive, heating to drive off solvent and raise the temperature to 300°F, and then feeding through rollers simultaneously with the specially formulated elastomeric vinyl sheet to produce the bonded laminate. Widths up to 48 in. have been fabricated.

It is said that the bond has sufficient strength to permit shearing, crimping, bending, drilling, punching, and deep drawing without fracture or loss of adhesion. Copper, brass and magnesium have also been successfully laminated, the latter being ideal for strong, lightweight luggage. Other products so far have been duct work, instrument cases, panel boards, automotive interior parts, radio and TV cabinets, office machine housings, wall surfacings, and containers.

If this development can be applied to plastic-coated steel pipe, with sufficient bond between the plastic and the metal to prevent lateral penetration of moisture in the event of accidental injury to the plastic, an effective corrosion resistant underground piping might become available to the gas industry.

Ground reservoir for heating oil

An ingenious semi-underground storage project, using a natural earth cavity, has been developed by the Esso Standard Oil Co. 68 miles west of its Baywood refinery at Linden, N. J. Esso has taken over an open-pit abandoned slate quarry, with a capacity of 1 million bbl, and is filling it with finished heating oil pumped from the refinery. During the heating season the oil will be returned to Linden for distribution in the New York Metropolitan area.

There are several interesting features in this unique project. No effort has been made to seal cracks in the slate walls or bottom of the pit, it being expected that hydrostatic water head in the surrounding ground will keep the oil from escaping. The oil will, of course, float on water, and bottom water is periodically pumped in or out to keep the proper level. Most amazing of all is a 700-ton floating steel roof, 1⅓ acres in area, which covers the entire pit to keep out air-borne contaminants and prevent evaporation. This roof is sealed around the edge with a 1 1/16-in. thick neoprene fabric, which permits a vertical movement of 3 ft. The roof has enough buoyancy to support any conceivable snow load, and is prevented from drifting sideways with wind pressure by eight spring-loaded horizontal cables, two anchored into each wall.

The investment for converting the quarry is stated to be 50 cents per barrel of storage capacity. One million barrels of heating oil is equivalent to approximately 5600 MMcf of 1000-Btu natural gas. ■

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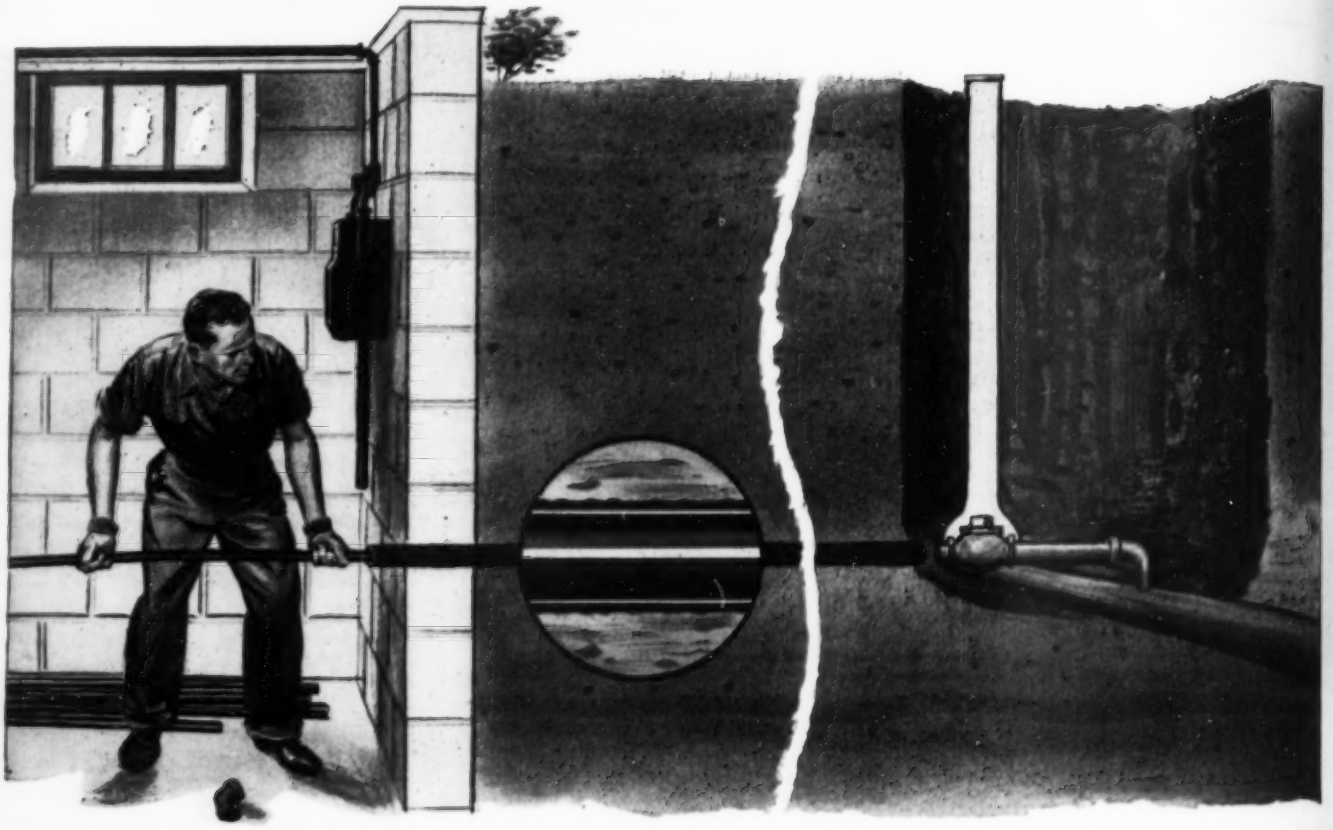

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GAS

OCTOBER, 1955

Natural gas is about to invade the next-to-last remaining major population center of the United States. There it will find a fast-growing market of almost limitless potentialities.

Natural gas for the Pacific Northwest

Part 1. The natural gas market

Natural gas for the Pacific Northwest is a subject with many parts. In doing this comprehensive treatment, the author has divided his story into two general headings, the distribution phase and the transmission phase.

The distribution phase is told on this and following pages in two parts:

1. *The natural gas market* 67
2. *The distribution companies* 71

The story of engineering and construction of the transmission pipeline is carried in the Pipeline Section, and subdivided as follows:

1. *The background.*
2. *Pipeline design.*
3. *Construction progress.*

By J. FRED EBDON • Managing Editor

THE Pacific Northwest market includes a regional population of about 5 million persons that has increased to this figure from perhaps 25,000 inhabitants living in the area 100 years ago. The 1 million mark was not reached until around the close of the century, so the majority of this healthy growth has taken place in the last 55 years. It is estimated that the regional population will be about 5.8 million people by 1960, and may be as high as 8 million by 1975. Similarly, the income in the Pacific Northwest has increased from $1.9 billion in 1940 to $7.6 billion in 1951. This, in turn, is reflected in a pattern of growth for the economy of the area.

The Pacific Northwest has been the favored area for government subsidized power projects, which have, to some extent, influenced the influx of industry to this part of the country; however, there are paradoxical factors that must be considered. For instance, the tremendous growth in population has outstripped the ability to provide employment for all, and it is an energy deficient area in spite of all the tax moneys that have been poured into its hydroelectric power projects. It has been estimated that by 1960 the electric power demand will exceed supply unless new generating plants (not currently under construction) are built in the meantime. Solid and liquid fuels imported from other states seem unable to stand the test of this demand although additional petroleum refinery capacity and

GAS staff report

The market... Natural gas will be used to generate ever-increasing electric power

crude oil pipelines are planned or under construction in some sections.

There is an answer to this energy failure in the states of Washington, Oregon, and Idaho—the Pacific Northwest Pipeline Corp.'s new natural gas pipeline that Fish Northwest Constructors is rapidly constructing from the San Juan basin to the Pacific Northwest. Natural gas is the fuel and energy source that will answer the question of where the total energy will come from to continue Pacific Northwest's expansion on a practical basis.

To see why this pipeline is on its way toward the Pacific Northwest with large volumes of convenient, efficient natural gas, it is well to study existing energy sources in more detail.

Electricity

The physiographic factors in the Pacific Northwest are conducive to favorable hydraulic movements therein. To the west, the Pacific ocean provides a limitless and constant reservoir of water along with prevailing winds capable of absorbing moisture through evaporative processes. These winds carry the moisture inland over the region's terrestrial continent. There are extra-tropical cyclones that develop from latitudinal shifts of wind belts during the cold season, and these along with the tepid influences of the warm Japanese Current, contribute to and increase the volume of evaporated water that emerges from the coastal waters.

When the moisture-laden maritime winds move in the prevailing easterly direction, they are forced to encounters with three successive moutain chains: (1) the Coast range (2) the Cascades, and, ultimately (3) the Rocky mountains. These barriers, lying athwart the trajectory of these winds, force them to higher altitudes where colder temperatures bring them to the point of saturation by increasing the relative humidity of the air; consequently, an abundant precipitation follows that produces the lush growth so typical of Oregon and Washington. While gravitating back to the ocean from whence they came, these run-off waters traverse a rugged terrain with rock formations of varying hardness and erosion resistance; therefore, alluvial erosion has produced numerous deep gorges, arroyos, and canyons with waterfalls, in some instances, and a generally rapid run-off of the surface waters.

Hydroelectric potential

These fortuitous circumstances provided in the main from the previously described geographical and meteorological forces mean that the Pacific Northwest region is blessed with one of the largest concentrations of hydroelectric potentiality on the North American continent. It is interesting to note, however, that only about 13% of this potential has been developed to date, and it has been estimated by experts in the field that not more than 50 + % can be practically developed. Further, without government subsidization, it has been estimated that probably not more than 30% will ever be developed because most of the more favorable sites for dams and equipment associated with hydro-power have already been used for this purpose. The point has been reached where the damming of less favorable sites will be much more expensive and the resultant cost per kw generated will be succeedingly higher.

The expansion of the federal government's participation in the hydroelectric power projects of the Pacific Northwest has been unusually large in the last 15 year. This is shown in *Table 1*.

The current administration does not seem prone to continue this swing from private to public ownership of electric generating facilities.

Of the total electric generating capacity in the Pacific Northwest, 84% of the name-plate rating capacity is produced by hydroelectric projects and the remaining 16% by the thermalelectric process. To produce the most efficient utilization of the hydrographic resources of an area, it is usually necessary to construct the storage reservoirs at upper approaches to the rivers and develop thermalelectric capacity to be used for standby during low-water periods. In line with this basic concept, most of the steam plants used to generate electricity in the Pacific Northwest are used for standby rather than for basic load requirements. The Corps of Engineers has plans for the development of 20 million acre-feet of storage capacity in that part of the Columbia River basin within the United States, but these estimates of the total storage capacity include a noteworthy percentage of so-called cyclical reservoirs, which would not fill within a year; therefore, should all these plans ever be consummated, it is very unlikely that the total storage potential would ever be available or utilized. Many experts have concluded that it is often cheaper to install thermalelectric facilities rather than to construct cyclical reservoirs.

Leading role

Thus, the statement that the electric power demands will exceed the supply by 1960 seems very real and advocates the introduction of natural gas into the area, not to primarily compete with electric power, but rather to help furnish fuel and energy to supply the demand that will not be forthcoming from other sources, including these hydroelectric power generating facilities. Natural gas may play the leading role in the de-

TABLE 1. PARTICIPATORS IN HYDROELECTRIC POWER PROJECTS

Owners of Electric Facilities	1940, %	1951, %
Private utilities	63.0	25.3
Industrial establishments	15.4	5.4
Federal Projects	6.4	60.1
Utilities of local public bodies	15.2	9.2

TABLE 2. GAS UTILIZATION COMPARISON

Utilization	Pacific Northwest, Percent	United States, Percent
Residential	65.7	32.7
Commercial	27.7	8.9
Industrial	6.6	53.7
Miscellaneous	0.0	4.7

velopment of the thermalelectric capacity that seems to prove advantageous when cyclical reservoirs and less desirable sites for dam construction are considered.

The Pacific Northwest is using electric power at a much higher rate than other sections of the nation. In addition, the increase in demand for electricity is much higher than is the same increase in other areas. The electric power will have to be generated or another source of energy found to take this increasing load. Natural gas will take a major portion of the increased load and will be used to generate ever increasing electric power to supply the lighting loads and free electricity for higher technological applications.

Coal

Commercial quantities of coal are found in the Pacific Northwest; in fact, it is the only fuel of major commercial importance native to the area. Unfortunately, the physical characteristics of the coal deposits are locally unfavorable for efficient mining. For example, the total estimated coal reserves in the region are around 64 billion tons, but only about 20 billion tons is considered recoverable.

The coal industry has been undergoing a gradual decline in the area during the last 35 years. Annual output dropped from approximately 4 million tons per year in 1918 to about 685,000 tons in 1953. The high cost of production, inefficient marketing, and loss of market to more favorable grades of imported coal and non-solid fuels contributed to this decline and what must be considered a total downfall, in not too many years. The small quantities of coal that are consumed are used in government institutions and for industrial heat and power purposes. As a basic source of energy, coal is of minor importance and will decline further as natural gas is made available.

Petroleum

The Pacific Northwest has little petroleum resources; therefore, all requirements for the many petroleum products used in modern American life and industry must be brought in from other states. California has been the traditional supplier of petroleum products to the region, but in recent years pipelines have linked the Rocky Mountain states with the Pacific Northwest and a lateral from the Transmountain Pipe Line of Canada is feeding oil to a new refinery at Anacortes, Wash., so the Rocky mountain and Alberta petroleum reserves have decidedly entered the picture.

New refinery capacity is being added at Bellingham, Wash., and at other points in the area. There is a possibility that these and the existing sources of petroleum products might give the withering manufactured gas companies (that soon will be distributing natural gas) some competitive trouble, but when the fact that the demand for petroleum fuels in the Pacific Northwest has increased over 125% during the last decade is brought to light, it seems obvious that the petroleum industry might be hard pressed to keep up with existing demands and the steadily increasing demands for its products from

TABLE 3. GAS SALES CONTRACTS

Customer and City to be Served	Applicable Rate Schedule	Maximum Daily Quantity (Mcf) From Initial Delivery to Following Oct. 31	From Following November 1 to Following Oct. 31	Thereafter
Bellingham Gas Co.				
Bellingham, Wash.	DI-1	1,000	1,400	2,011
California-Pacific Utilities Co.				
La Grande, Ore.	DS-1, DI-1(1)	680	880	1,080
Cascade Natural Gas Corp.				
Eugene, Ore.	DI-1	1,500	2,500	4,000
Grandview, Wash.	DS-1	195	235	335
Milton, Ore.	DS-1	64	85	105
Pendleton, Ore.	DI-1	1,000	1,480	1,740
Prosser, Wash.	DS-1	195	235	335
Sunnyside, Wash.	DS-1	280	380	525
Toppenish, Wash.	DS-1	430	515	700
Walla Walla, Wash.	DI-1	2,000	2,800	3,200
Yakima, Wash.	DI-1	1,500	2,300	2,900
Total additional service to above towns under I-1 and S-1 Rate Schedules	I-1(2)	8,650	8,650	8,650
	S-1(2)	8,279	8,279	8,279
Colorado Interstate Gas Co.	PL-1	100,000	100,000	100,000
Seattle Gas Co.				
Seattle, Wash.	DL-1	21,300	32,300	40,000
	I-1(3)	10,500	10,500	—
Spokane Gas & Fuel Co.				
Spokane, Wash.	DL-1	14,000	20,000	27,000
The Dalles Natural Gas Co.				
The Dalles, Ore.	DS-1	610	700	850
Twin Cities Gas Co.				
Longview and Kelso, Wash.	DI-1	3,323	4,817	5,749
	I-1(3)	2,750	2,750	—
United Gas Corp. of Washington				
Camas and Washougal, Wash.	DS-1	900	950	1,000
	I-1(4)	13,250	13,250	13,250
Washington Gas & Electric Co.				
Centralia and Chehalis, Wash.	DS-1	260	490	718
Everett, Wash.	DS-1, DI-1(1)	470	840	1,260
Tacoma and Olympia, Wash.	DI-1	3,440	5,050	6,970
Wenatchee Gas Co.				
Wenatchee, Wash.	DS-1, DI-1(1)	737	888	1,105
Direct industrial sales under contract:				
Pocatello and Payette, Idaho		3,200	3,200	3,200
Total volumes under contract (firm basis)		157,084	182,045	204,775
Total volumes under contract (interruptible basis)		43,429	43,429	30,179
Total volumes under contract		200,513	225,474	234,954
Idaho Natural Gas Co. (5)		41,660	41,660	55,940
Total volumes under contract and offer to purchase		242,173	267,134	290,894

(1) Rate schedule applicable to deliveries in the third year and thereafter.
(2) Contract terminates Oct. 31, 1960.
(3) Contract terminates Oct. 31, 1957.
(4) Contract terminates Jan. 1, 1958.
(5) No gas sales contract has been executed, but Idaho Natural has offered to buy the aggregate volumes shown for service to 27 cities and towns in southern Idaho under whichever of Pacific Northwest's rate schedules are applicable.

The market... Natural gas will cut into the heating load now dominated by fuel oil

applications to which natural gas is not practical. Some local petroleum products dealers and their associations are crying loudly about the ruin that will befall them when natural gas comes blowing through the Pacific Northwest pipeline; however, in view of the markets that are there and will always be there for petroleum derivatives, we can't seem to generate many tears on the behalf of the mighty petroleum industry.

Fuel oil is likely to be the petroleum product hit hardest by the introduction of natural gas. Recent statistics show that fuel oil usage in the Pacific northwest breaks down as follows:

Heating	33.7%
Railroads and ships	23.4%
Manufacturing and mining	19.7%
Utilities	7.9%
Miscellaneous	5.3%

Natural gas will cut into the heating load now dominated by fuel oil and will take its share of the manufacturing and mining load. Too, the utilities' load will be substantially reduced as a major percentage of this fuel oil is used to produce oil-gas for the manufactured gas distributing companies.

Gas operations

The growth of gas operations in the Pacific Northwest has not kept pace with the astounding average growth of the industry over the nation. The lack of growth might seem to be due to the serious competition the Pacific Northwest's gas industry faces from local and federal government-owned hydroelectric power plants; however, the primary reasons for the lack of growth are: (1) the unavailability of natural gas, and (2) the shortage of low-cost gas in adequate volumes in the area. The latter situation developed because of the lack of firm domestic load to justify construction of the plant capacity necessary to attract industrial expansion. A comparison between the utilization of gas in the Pacific Northwest and the rest of the United States is shown in *Table 2*.

When Fish Northwest Constructors completes Pacific Northwest Pipeline's transmission line into the area, there will be ample volumes of natural gas available to build the industrial load to offset the present imbalance.

The history of the gas industry in the Pacific Northwest is less than spectacular. Coke-oven gas was originally upon the scene, but fell away to nothing by 1947. Water gas dominated the gas markets until 1946; since then, it has fallen rapidly into unimportance. Oil gas from imported petroleum has been the basic gas for city distribution since 1946 and liquefied petroleum gas has been sold in considerable volumes in the area—13.5 million therms of LPG as compared with 73.4 million therms of manufactured gas.

Natural gas activity in the Pacific Northwest has been nil except for some wildcat drilling. In 1954, the following unimpressive drilling statistics were produced:

Location	Number of Wells	Production
Idaho	1	Dry
Oregon	1	Dry
Washington	7	Dry—7

Slight drilling activity has continued during 1955. One gas well has been completed as a commercial producer, and others are drilling at the present time.

Total gas sales in the region were 86.9 million therms during 1954. This can be compared with 9305.9 million therms sold in Texas and 7607.5 million therms sold in California during the same period. Obviously, it is not a gas-accustomed area, but the past isn't too important at this time. The prime consideration will be the ability of these gas distribution companies to move forward with the aid of the impact that the arrival of natural gas will bring with it. This natural gas—the first source of economical fuel and energy in adequate quantities ever to enter the Pacific northwest—will be the tool for development of the gas industry there. As in other regions that natural gas has been brought into through long distance transmission lines, the growth of the gas industry will be the yardstick for the growth of the other industries and one of the basic means of industrial development.

The natural gas market

Pacific Northwest Pipeline Corp. has been certificated by the FPC to sell natural gas for resale in the states of Washington, Oregon, and Idaho. As the line currently under construction by Fish Northwest Constructors winds its way through Colorado, Utah, and Wyoming, in addition to the states previously mentioned, Pacific Northwest also gained authority to sell gas to towns and cities along its route. Then, it is authorized to sell gas to the Colorado Interstate Gas Co. at a delivery point near Rock Springs, Wyo.

A tabulation of the gas sales contracts in force at the closing of certification is shown in *Table 3*.

Since the development of these plans Portland Gas & Coke Co. has signed up as a customer; additional municipal gas systems have been formed through successful bond elections; Cascade Natural Gas Corp. has extended service to four additional towns with propane-air gas; plans have been made by Kootenai Natural Gas Co. to serve four towns with natural gas; Twin Cities Gas Co. proposes to serve three or four towns in the Olympia-Grays Harbor (Wash.) area; and Pacific Northwest Pipeline Corp. proposes to supply gas to the British Columbia Electric Co. Ltd. for the Vancouver, B. C., markets through delivery at the Canadian border to Westcoast Transmission Co. Ltd. until such time as Westcoast can construct its facilities to serve this market with Alberta gas. Pacific Northwest now has exhibits on the docket of FPC that will allow them to proceed with plans to to take care of these newly developed loads, if certificated.

Also, since announcement of the above detailed plans, Idaho Natural has been franchised in nine Idaho towns and is in process of obtaining the necessary franchises in 20 additional towns and cities.

Distribution companies

PORTLAND GAS & COKE CO.

Metropolitan Portland is a city of 704,000 people located on the Willamette river just south of its junction with the Columbia river and 110 miles from the Pacific ocean. The economy of the area once rested almost entirely on timber cutting, agriculture, and food processing. The timber industry is still big; woods of every description and for practically all uses—soft, medium hard, and hard—common and rare—thrive in the immediate vicinity, but the development of new industry seems to overshadow the traditional one.

Three aluminum-reduction plants spearhead the birth of the electro-metallurgical industry and aluminum fabricating plants have been constructed for the companion industry. Other industries that have moved into the Portland region are: electrochemical, pulp and paper, grain milling, machinery and tool manufacturing, textiles, furniture, and other wood products. There is every reason to believe that the chemical, ceramic, and glass industries will soon be there to enjoy the benefits of the area when coupled with those natural gas' introduction will bring with it.

Biggest seller

Portland has been using manufactured gas produced by the Portland Gas & Coke Co. for the past 95 years. Since this early date, Portland Gas has extended its service area to 80 towns and cities in the Williamette valley in Oregon, and across the Columbia river to Vancouver, Wash. and vicinity. This company sells more gas than the combined sales of all the other gas companies in the Pacific Northwest. It has been able to do this in spite of the fact that the Portland area has more than 100 hydroelectric power-producing dams serving it—a fact that makes it the most electrified area in the United States even while it is in the most electrified section of the nation. This, coupled with favorable transportation rates and a good water supply has helped the industrial expansion of Portland. Natural gas will help it more.

Under current agreements with Pacific Northwest Pipeline Corp., Portland Gas & Coke Co. will be supplied natural gas at an estimated cost as shown in *Table 4*.

Continued operation

Portland Gas plans to continue operation of its manufactured gas production plant for peak shaving and demand shaving during certain parts of the year. The by-products end of the plant will cease production of carbon in the face of a declining market for this commodity. The light oil and tar production will be continued as there is a ready and profitable market for these. The gas-making facilities will also be used for insurance of the continuity of gas service, for although the Pacific Northwest Pipeline Corp. plans, as expanded, will provide for gas supply from two sources —the San Juan basin and Canada's Peace river area—the Oregon system of Portland Gas will be entirely dependent on a single pipeline crossing of the Columbia river from the mainline in Washington. So, as standby units, the gas-making facilities will be very worth while.

After considerable research, Portland Gas' engineers have successfully converted four gas generators to the production of high Btu gas (1000 Btu per cu ft) that is compatible for blending with the 1000-Btu-per-cu-ft natural gas that will be delivered by Pacific Northwest. The remaining generators will be converted to high Btu service prior to the time natural gas becomes available. The fully converted gas-making plant will have an estimated capacity of 300,000 therms (30 MMcf) per day of high Btu product. The company will spend about $500,000 on this plant conversion program.

In addition to the manufactured gas generators, Portland Gas now operates five LPG plants with a combined capacity of 665,000 gal. and a generating capacity of 14 MMcf per day. This end of the business will be increased both in storage and plant to produce a generating capacity of 33.2 MMcf per day.

Thus, the total peak shaving, demand shaving, and standby capacity of the company will be:

Type of Gas	Therms	Mcf (@ 1000 Btu)
Oil gas	300,000	30,000
LPG	332,000	33,200
Total	632,000	63,200

Portland Gas & Coke Co. now operates about 2466 miles of distribution mains. A small percentage of these are cast iron; the remainder are steel. The company doesn't anticipate any unusual troubles in the conversion phases and has retained Conversions & Surveys Inc. (a division of Stone & Webster) to engineer and supervise the conversion program. Portland feels that the timing of the conversion will be most important and it has decided against adding to its 27,000 spaceheating customers until after the conversion to natural gas is accomplished. The engineering boardwork for the design of the system expansion is well underway.

Portland Gas plans to spend the following amounts to provide for expansion under natural gas service:

TABLE 4. COST OF GAS TO PORTLAND GAS & COKE

Time Factor	Load Factor	Cost, per Therm	Cost, per Mcf
First full year	92.5%	3.14¢	31.4¢
Second full year	91.3%	3.16¢	31.6¢
Third full year	90.4%	3.17¢	31.7¢
Fourth full year	89.6%	3.18¢	31.8¢

Distribution companies... Advertising and sales campaigns will be stepped up and augmented

Year	Expenditure
1955	$1,156,000
1956	$5,516,000
1957	$1,977,000
1958	$2,596,000
1959	$2,435,000
1960	$2,387,000

Fully 65% of these moneys will be required for system expansion to permit connection of new industrial, commercial, and residential loads.

Major construction items are: Liquefied petroleum gas facilities, $705,000; distribution main additions, $7,240,000; customer service lines, $3,531,000; meters and regulators, $2,289,000.

In addition to these expenditures that will be capitalized, nearly $3.3 million will be spent for the conversion program itself, that is, the actual changeover program, including the conversion of appliances presently connected.

Portland Gas' advertising and sales campaigns have been stepped up and will be further augmented. The kickoff date for the intensive sales program was May 18, 1955. The aggressiveness of this company prior to the arrival of natural gas at its town border stations indicates that it is out after the business and doubtless it will get it. From 1950 through 1955 the company spent some $2 million on sales; from 1956 through 1960, it plans to dedicate $2.8 million for load development sales work. After natural gas arrives, Portland Gas & Coke will concentrate on basic load promotion and advertising, gas cooking demonstrations, industrial and commercial gas utilization, engineering, and dealer sales training.

C. H. Gueffroy, president of Portland Gas & Coke Co., was outspoken in his opposition to Pacific Northwest's initial plan to bring the natural gas to the Pacific Northwest without interconnection to Canadian reserves; however, when the FPC certificated Pacific's application, Mr. Gueffroy worked hard on the compromise agreement between Westcoast Transmission, El Paso Natural, and Pacific Northwest that was announced from the Sunray Oil Corp. offices in Tulsa to the surprise of many in the gas industry.

Mr. Gueffroy feels that the customers and others in the service area of Portland Gas are ready for natural gas. He contemplates construction of a new line to Oregon City to reinforce existing lines and capacity to that point. At the time of our visit with him, they were ready to negotiate contracts (rates) with about 17 major industries that will be potential consumers. He is well pleased with the security afforded by the connection of two major gas supplies to the Pacific Northwest pipeline and the design of the line which Fish Engineering has engineered to provide two-way flow.

James F. Bell, vice president of the company, points to two main fields of industrial expansion that can be expected after natural gas is available to the company: (1) the manufacture of gas appliances of all types in the area should obviously grow, and (2) the petrochemical industry should develop with natural gas available as a fuel and the extracted hydrocarbons and inorganic materials produced coincidentally with natural gas processing should furnish basic raw materials for this industry.

SEATTLE GAS CO.

The city of Seattle and its surrounding market area has experienced at least the same growth that has been driving the entire Pacific Northwest region. It is and has been a major port and has been vying with Portland for years for the undisputed crown of Gateway to Alaska and the Orient. Traditionally, Seattle was a center for the lumbering and fishing industries. These basic endeavors are still important to the economy of the city and its environs. However, there has been some growth toward diversity under the influence of the establishment of markets that have caused some large companies to produce their products in the Seattle market area for consumption therein. This development ties in with freight rates and other economic considerations.

A few industries—notably Boeing—have located near Seattle from historic influences rather than peculiar advantages of the region. This company currently produces its eight-engined B-52 bomber and jet tanker-transport there and employs many thousands of people. Recently, Boeing has received authority to produce a jet-powered transport aircraft for civilian airline consumption. This company is a major factor in Seattle's economy.

The lumbering industry has diversified its production around Seattle so that there is considerable manufacturing of pulp, plywood, hardboard, etc.; these activities have removed some or most of the waste wood products from the fuel supply field, that is, scrap lumber, shavings, sawdust, and hogged fuel used to find usage as fuel for many purposes, but since so much of it is now used for the production of wood byproducts, it has been priced out of the fuel market. Some of the lumber mills will turn to natural gas to replace waste wood fuel previously used.

The economy around Seattle cannot be described as having boom proportions, but with large orders for aircraft backlogged and industrial growth in petroleum refining, aluminum, and pulp and paper activities forecasted, there seems to be little doubt in the future progress of the economy. Natural gas will influence and act as a catalyst for this industrial expansion.

Industries that may well be developed in and around Seattle following the introduction of a natural gas supply are: (1) flat glass making, (2) production of high grade ceramics, and (3) petrochemicals. For the glass making the needed special glass sands, feldspar, and soda ash seem to have adequate sources in the area. The ceramics industry can use these minerals and raw materials to advantage also. Other industries that could develop are the production of viscose, rayon, and cellophane. Anhydrous ammonia, formalde-

hyde, etc., seem to be promising in the petrochemical field. It would seem logical to produce some of the glues needed in the manufacture of plywoods, and associated materials, in the area of the plants that produce much of these materials.

The Seattle Gas Co. has served a market based on the City of Seattle with manufactured gas for a number of years. During this tenure, it has had its ups and downs, but at the present time seems to be on even keel and ready to exploit the business advantages that will accrue to it through the introduction of natural gas.

N. Henry Gellert served as the company's president during a period of rebuilding that coincided with the prolonged negotiations and maneuvering of the natural gas transmission companies desiring to serve the Pacific Northwest. He was a staunch supporter of the Pacific Northwest Pipeline Corp.'s plans to supply the gas from the San Juan basin. After revitalizing Seattle Gas to its present position as a strong gas company and seeing the Pacific Northwest plan certificated by the FPC, Mr. Gellert resigned to return to his profession of executive consultant to public utilities, bankers, and industry.

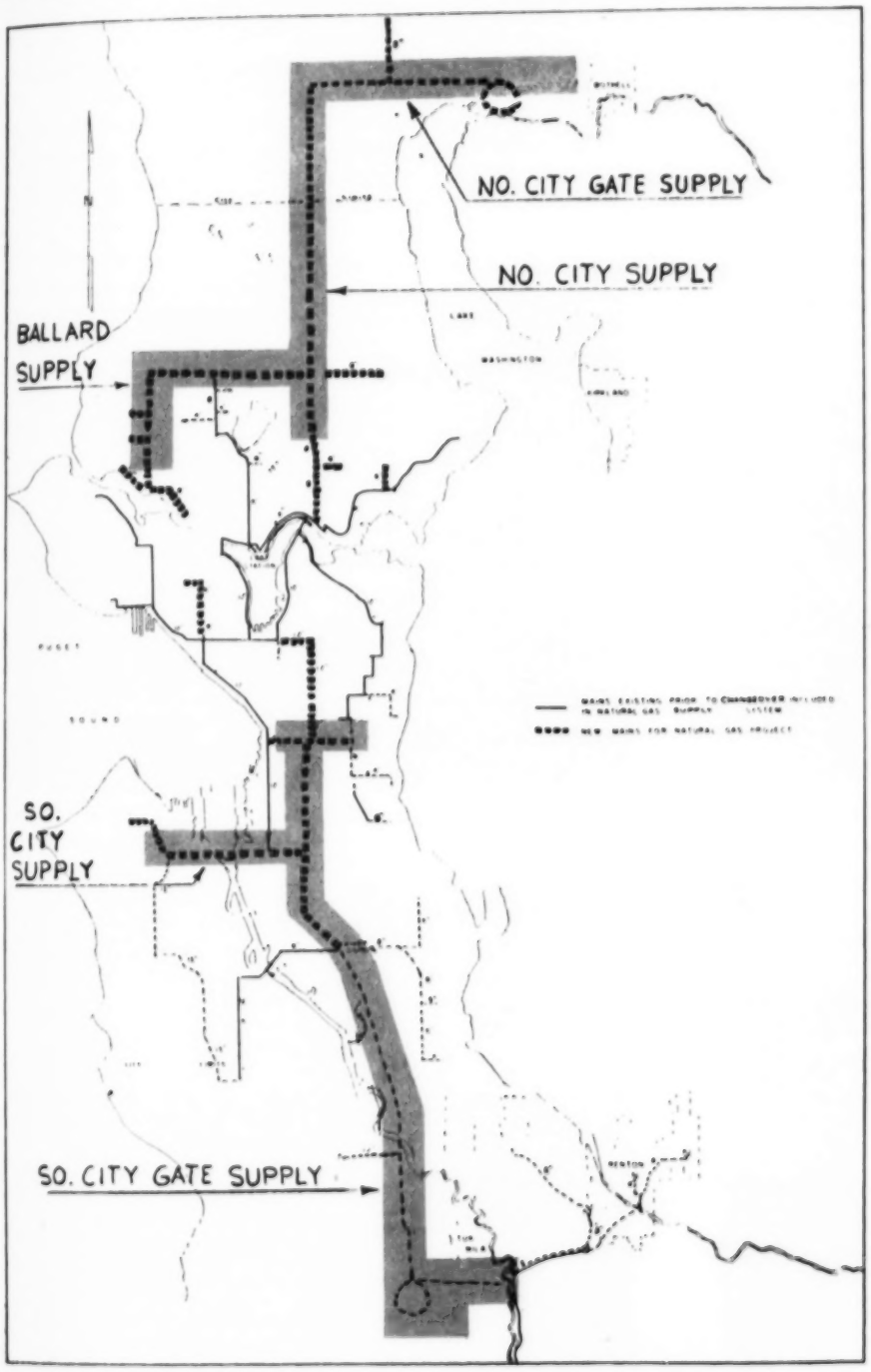


Fig. 1. Simplified map of Seattle Gas' construction to feed natural gas to its distribution system.

Walter S. Byrne succeeded to the presidency of Seattle Gas on March 15, 1955, and brought with him more than 30 years' experience in the utility field with about 15 of these years spent in converting to, and operation of, natural gas in distribution companies.

The highlight of the recent history of the Seattle Gas Co. has been the proposed merger between it and Washington Gas & Electric Co., Tacoma, Wash. Stockholders have practically unanimously voted in favor of the merger of the two companies and it is expected to become effective on Nov. 1 of this year providing the Washington PUC approves the move. After that is accomplished, the name Washington Natural Gas Co. will be used.

The merger is very logical under the operating set-up of the two companies. Their service areas have a common north and south, respectively, border and each needs the help of the other to consolidate the market and expand in every direction from the cities of Tacoma and Seattle, which have actually grown together for all practical purposes. It constitutes one big natural gas market that can be more efficiently served by a single utility. The merger will produce advantages in load factor —it has been estimated that the load factor will be near 100% after the merger and, of course, thereafter there would be a single billing to the combined companies and there would be the resulting improvement in the demand charge. After the merger, Washington Natural Gas Co. would have a franchised service area embracing 1.25 million people.

Seattle Gas has found itself in the unique position of selling more gas each year for the past few years, but at the same time it has been steadily losing in the number of customers served during the same period. In the service area, the domestic consumers of public services generally space heat with fuel oil, cook with electricity, and water heat with electricity.

The company is making the greatest effort in sales toward the recovery of of the domestic spaceheating load. It wants this load because: (1) it increases the average consumption (and average bill) per customer, (2) it tends to decrease the average selling price of the gas on a thermal basis, and (3) the impact of weather fluctuations on gas sales increases as the proportion of heating business becomes greater. This at-

Distribution companies... Seattle Gas expects natural gas to encourage new industries

titude is reflected in the statistics on heating customers from this company; for instance, in 1945 Seattle had 4000 residential and commercial spaceheating customers. In 1954, it had 8300 consumers making use of gas for this application. It expects to get a big majority of the new spaceheating business as homes and businesses are constructed and at the same time expects to hold its own with new cooking and water heating installations. For the first five years after it starts distributing natural gas, Seattle Gas expects to add 7000 domestic spaceheating customers per year—an aggregate of 45,000 for the period.

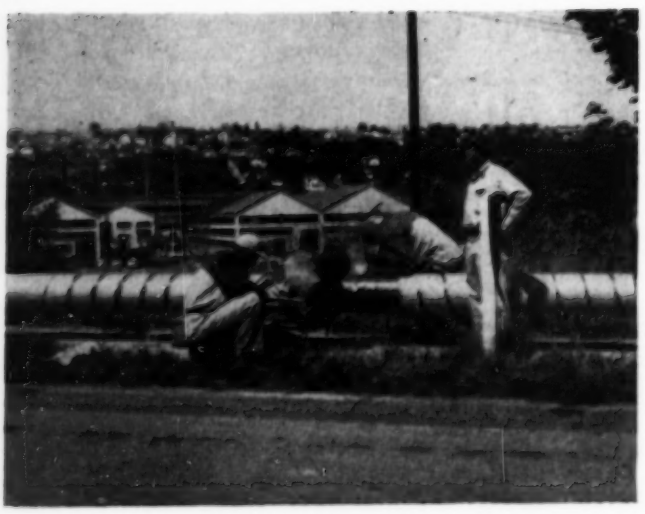
Seattle Gas will work on its industrial load by intensifying sales efforts and extending the distribution system so that adidtional customers can be connected, and adequate volumes of natural gas delivered. It had a good year from its industrial customers during 1954 and expects the technical advantages of natural gas to increase industrial sales to existing consumers in this classification and to encourage the establishment of new industries in the area.

The present distribution system of the Seattle Gas Co. comprises about 1080 miles of mains — 80% of this mileage is cast iron pipe and most of the distribution system is operated at utilization pressure. The cast iron pipe joints are lead packed and the system is estimated to be pretty clean, so the company doesn't contemplate the elaborate conversion programs that have characterized the conversions from manufactured to natural gas service by some of the gas companies in the eastern part of the nation. All the gas it produces in its oil-gas generators at the present time is compressed, and aftercoolers were installed in 1951, so gums, tars, sludge, and dusts have been kept to a minimum. Also, dust filters have been used on the customers' meter installations, so orifices and natural traps should be relatively clean. Another factor that should contribute to an easy conversion program is the fact that the majority of connected appliances are relatively new and of relatively good quality—the company doesn't expect to run into the antiques and luminous

Fig. 2. Construction work is underway as Seattle Gas prepares for the arrival of natural gas.

Trencher makes ditch for distribution main . . .

Pipe is cut and beveled prior to final alignment . . .



Tie-in weld is completed . . .

And the main is lowered into the trench.

Fig. 3. Steve Richards, Seattle Gas technician, inspects the two-pen recorder serving the new regulator station (left). At right is shown the new vault-type district regulator station Seattle has installed in preparation for the arrival of natural gas.

burners that were a plague to the eastern companies. With some light oil fogging, it should be a pretty clean changeover although bell clamping joints will probably go on for several years.

Straight natural gas will be distributed in Seattle and in other Seattle Gas service areas. The trunk lines will come into the city from the north and south, but will not be extended to the present manufactured gas plants. The plants will be left in shape for gas production, but will be used only on an emergency basis, if ever this is necessary.

Border stations

Two major town border stations will be constructed *(Fig. 1)*, a third will be built for a newly franchised area, new mains installed, mains renovated, pressure limiting regulators installed, and other installations constructed prior to turning natural gas into the system. A breakdown of the estimated cost of this work that must be accomplished before the arrival of natural gas is shown in *Table 5*.

Of this amount, $134,000 in main construction has been completed; therefore, there remains $2,818,500 worth of improvements to be constructed before the Pacific Northwest pipeline is completed to Seattle—less any completed construction between the time this material was gathered and the publication of this issue.

There was about $800,000 in construction being done on the south city supply system at the time we visited Seattle. (See *Fig. 2.*) This covers the installation of about 12 miles of 12-, 16-, and 20-in. OD welded steel main. The Duwamish river was crossed (underwater) for this project. The pipe was mill wrapped with Koppers and Rielly pipeline enamel and the river crossing pipe was given three coatings of pipeline enamel, two wraps, and 1½ in. of concrete coating to produce adequate negative buoyancy.

The over-all (5-year) construction program for building the supply system and expanding the distribution system has been estimated to involve an expenditure of $15.5 million. About 12,000 tons of steel will be required for new construction—Kaiser Steel Corp. will supply about 600 tons of this as API-5LX42 pipe; Youngstown Sheet & Tube Co. will supply another 500 tons; and the remaining 100 tons will be small diameter for service lines and the like and will be obtained from various suppliers.

Rockwell Manufacturing Co. will supply about 235 Rockwell-Nordstrom lubricated plug valves for sectionalization. These plug valves will be a special pattern that has extended ends for cutting-in and installation with mechanical-type couplings. These will be needed for control of the turn-in program that will involve about 250 purging points.

Seattle Gas Co. is meeting the challenge of expansion that will come to it as Pacific's line moves into the area. It will be favorably situated for supply from either the San Juan basin or the Peace river reserves and should enter a completely new era of industrial load building and house spaceheating development. After consolidation of these loads, it will campaign for the other domestic applications. Its sales program has already been launched and it is moving forward with the inertia resulting from the impending supply of a new, efficient source of fuel in adequate volumes.

TABLE 5. SEATTLE'S CONSTRUCTION COSTS PRIOR TO ARRIVAL OF GAS

Mains, approx. 40 miles	$2,665,500
Pressure limiting stations	15,000
Controls, remote and automatic	65,000
Foggers, odorizers, and dust control	63,000
District regulator stations	39,000
Sectionalizing	105,000
Total	$2,952,500

WASHINGTON GAS & ELECTRIC CO.

Under a revitilized management team headed by Nathaniel F. Glidden, chairman of the board; Allen Peyser, president; and Bernard T. Poor, vice president and general manager, Washington Gas & Electric Co. has been in the process of emerging from some bad years. During the six years this management has been in operation, the steady improvement the company has experienced can be illustrated by the tabulation of net income that follows:

1949	$153,313 loss
1950	62,821 loss
1951	22,439 loss
1952	3,652 profit
1953	51,001 profit
1954	54,078 profit

The Tacoma area is not one that would by its nature cause a gas company to flounder. The poor years were due to inadequate plant capacity, inability to secure capital for plant expansion, and poor maintenance of the system. The fact that the situation has changed from a loss to a profit reflects that the area can be served gas at a pay out and probably can be expanded.

Tacoma is a fine port that has set up a port district commission that assures the availability of lands adjacent to tide water for those industries desiring to locate in the area. To date, this program has been successful. Industry in the area includes facilities for producing newsprint, specialty paper, an aluminum reduction plant, chemicals, water glass, plywood, roofing, canned vegetables and fruit, fiber boards, and beer.

For the last six years the expectation of natural gas has been fundamental in the planning at Washington Gas & Electric. During the past year, more than $61,000 was spent on new business and $15,700 was spent on replacement of mains and leakage reduction. Conversions and Surveys Inc. has been retained to supervise and carry out the conversion of customer's appliances to utilize natural gas. Preliminary planning and experimental work in preparation for the change-over have been started.

Washington Gas & Electric Co. will merge with Seattle Gas Co. to form the Washington Natural Gas Co. and provide for more efficient natural gas distribution operations. Actual construction has been delayed until after the merger is completed.

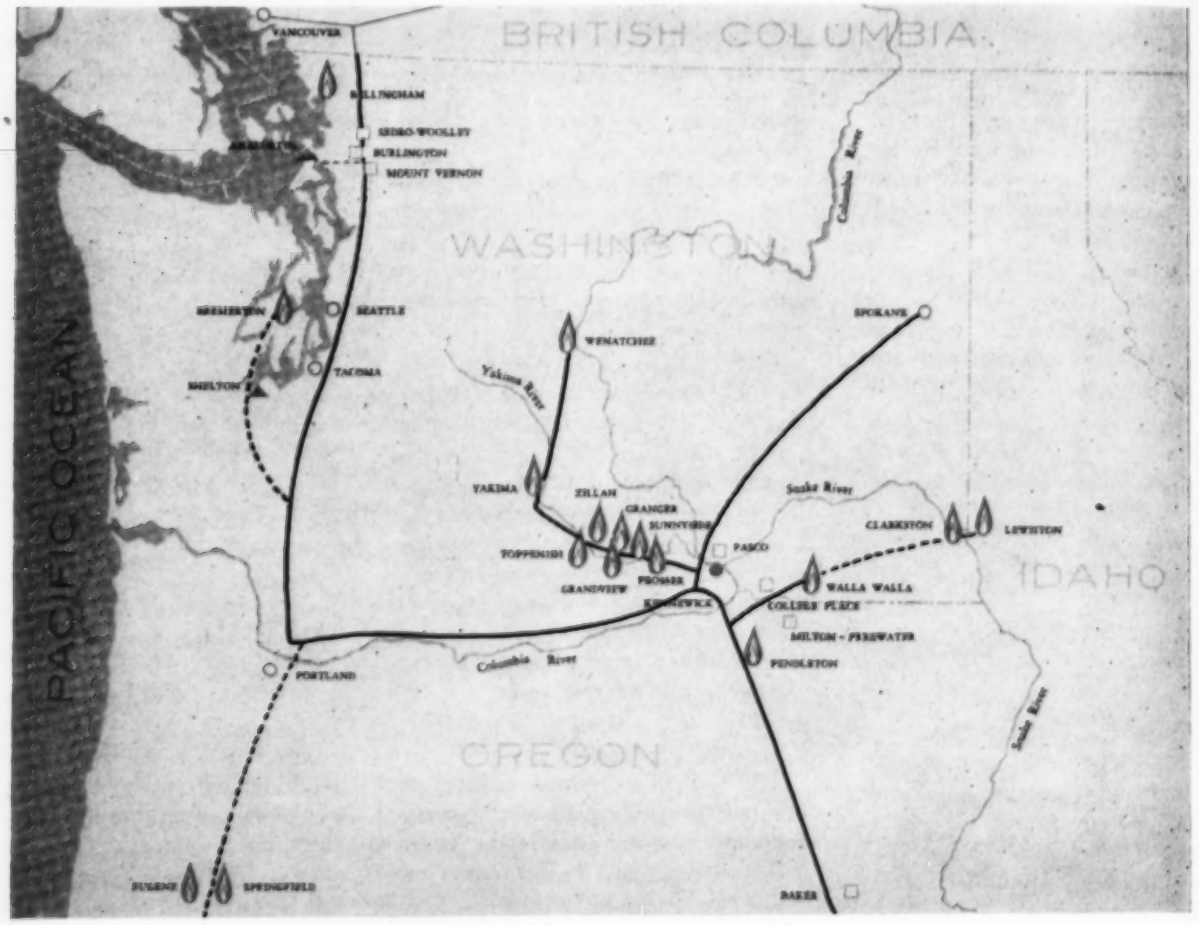


Fig. 4. Area to be served by Cascade Natural Gas Corp.

CASCADE NATURAL GAS CORP.

Cascade Natural, under the direction of Stewart Matthews, president, was formed in 1953 because the organizers felt that the integration of a number of small gas companies of several types into a larger organization would have advantages for possibilities of large-scale financing; centralization of engineering, accounting, and management; and generally produce many other factors leading to efficient operation. The first acquisition was the Bremerton (Wash.) Gas Co., and then the cities of Yakima, Walla Walla, and Clarkston, Wash.; Lewiston, Idaho; and Pendleton and Eugene-Springfield, Ore. became units of the Cascade organization.

Many other cities, towns, and communities have been formed into the company since the early operations. It presently serves 23 cities in Washington, Oregon, and in Idaho. It has a new franchise for the town of Kennewick, Wash., and has filed for franchises at eight additional communities in Washington and two more in Oregon. (See *Fig. 4.*)

Currently, Cascade has 11,000 customers. Considerable rehabilitation work has been done on the existing distribution systems and more is planned prior

to the conversion of most of these systems to natural gas.

Cascade Natural has signed contracts for natural gas service to all of its properties except Lewiston, Clarkston, Bremerton, and Shelton. These cities will be picked up on natural gas service should Pacific Northwest's plans now waiting certification become approved. Pacific Northwest has allocated gas supplies for the cities in which franchises have been filed, so these can be served with natural gas as Cascade receives franchise.

Fish Service & Management Co. has been retained as engineers to make the estimated construction costs for the expansion of Cascade's underground system and the costs for new systems as required; market surveys and estimates of rate of conversion and expansion; anticipated rate structure and forecasts of earnings.

After Oct. 1, between $11 and $12 million will be expended in preparation for natural gas and to expand the system. Stewart Matthews expects the system to have about 44,000 customers at the end of the first full year of natural gas service and more than 70,000 at the end of the fifth year.

THE VANCOUVER, B.C.-FRASER VALLEY MARKET

The Fraser Valley is the largest trade and industrial area in western Canada due to its having a world port that forms the base of commerce for British Columbia and provinces close to it. Its economy has been founded on the mineral and forest resources of the area, and these will probably be the basis for industrial growth in the future. A well developed shipbuilding and repair industry has been born to augment the lumber mills, pulp and paper plants, fishing, fish curing and packing, and meat packing industries. Other major industries involve food processing and packing, fruit crops, vegetables, dairy products, fertilizers, chemicals, iron and steel products, and machinery.

This market may be initially served with gas from the Pacific Northwest pipeline if present plans are certificated. In any event, sooner or later the market will revert to Westcoast Transmission and Peace river gas. British Columbia Electric Co. Ltd. will distribute the natural gas to the Vancouver area.

SPOKANE MARKET

Prior to World War II, the major industries of the area were mining, agriculture, and lumber. During the war, an aluminum reduction plant was constructed and now there is a rolling mill and a magnesium plant to spur the metals industry.

Spokane Gas & Fuel Co. has plans for spending an estimated $5 million for system conversion and expansion. Under the leadership of its new president, Nathan H. Gellert Jr., Spokane Gas plans to extend service throughout Spokane and the Spokane Valley.

IDAHO MARKET

The Idaho Natural Gas Co. was formed to serve some 33 communities that do not enjoy any type of central gas service at this time. It is a completely new company certificated by the Idaho PUC to build and operate the natural gas distribution system.

George W. Carpenter, president of Idaho Natural, plans to start construction about March 1956, and have the system essentially completed during the summer months. He reports that they are franchised in nine cities and are actively working on securing franchises in 20 odd towns, cities, and communities in southern Idaho.

Idaho Natural plans to lay about 700 miles of steel pipe for its distribution systems and expects to be serving about 45,000 customers within five years. The maximum daily demand at that time will approximate 95.5 MMcf. It has arranged with Stone & Webster Service Corp. to provide advisory services in connection with the company's operation.

Southern Idaho constitutes an important mineral producing and agriculture area. Natural gas should furnish a needed impetus to the industrial development of the area, but the growth probably will not be as great as that for Washington and Oregon.

OTHER MARKETS

The existing and possible mineral-producing potential is the key to developing industrial market for gas in the lower area of the Pacific Northwest mainline. True, the line will deliver to gas systems all along this part of the ROW for domestic and commercial consumption—these loads are not to be ignored; however, they are somewhat overshadowed by the potential of the mining and minerals processing industries.

The Paradox formation that underlies Delores, San Miguel, Montezuma, and Montrose counties in Colorado, and San Juan and Grand counties in Utah, contains extensive deposits of potash salts similar to those found in New Mexico's potash belt. Potash can be obtained from these minerals by fractional crystallization. Natural gas is used for heating the solutions in this process in New Mexico, so it follows that should this industry develop in the described areas, a fine natural gas load would be developed along with it.

The Colorado Plateau region, with a center roughly on the San Juan basin, produces a good percentage of the uranium resources of the nation, but the mines are small and widely scattered. Several of the mills—such as Durango, Naturita, Rifle, and Uravan in Colorado, and Monticello in Utah—have worked out processes that use natural gas. Gas may be used for ore drying, roasting the slime filter cake, heating acid solutions for hot leaching, and in fusion furnaces for purification of uranium and vanadium. In view of the intense hunt for uranium and vanadium, and the success that has been realized to date with unrefined exploration techniques, there seems to be little doubt but what this industry could prove a very healthy industrial load in not too many years.

Many, many other minerals and their derivatives are in the area and are being worked or will be as new deposits are discovered. Most of these will welcome the passage of a natural gas pipeline through the area and will take gas in varying quantities. There is a good potential industrial load in this part of Pacific's operations. ■

FOR PIPELINE CONSTRUCTION PROGRESS STORY, TURN TO PAGE 177

AGA candidates for 1955-1956

D. H. Mitchell

C. H. Zachry

A. W. Conover

V. T. Miles

M. A. Abernathy

P. E. Beckman

R. E. Crawford

L. C. Harvey

J. E. Heyke Jr.

D. E. Karn

W. H. Ligon

C. L. May

R. W. Otto

F. T. Parks

J. C. Peterson

W. F. Rockwell

E. H. Smoker

J. T. Wolfe

D. K. Yorath

E. R. Eberle

J. H. Carson

L. E. Biemiller

J. H. Collins Sr.

B. H. Wittman

W. D. Sweetman

L. A. Brandt

J. R. Delaney

G. Lawrence

V. F. Bittner

W. D. Williams

Who's Who (at left)

Dean H. Mitchell, Northern Indiana Public Service Co., Hammond, president; C. H. Zachry, Southern Union Gas Co., Dallas, first vice president; A. W. Conover, Equitable Gas Co., Pittsburgh, 2nd vice president; V. T. Miles, Long Island Lighting Co., Mineola, treasurer; M. A. Abernathy, United Gas Pipe Line Co., Shreveport, La., director; P. E. Beckman, Pacific Gas & Electric Co., San Francisco, director.

R. E. Crawford, Minnesota Valley Natural Gas Co., St. Peter, Minn.; Lyle C. Harvey, Carrier Corp., Syracuse, N. Y.; John E. Heyke Jr., Brooklyn Union Gas Co.; Dan E. Karn, Consumers Power Co., Jackson, Mich.; Wister H. Ligon, Nashville (Tenn.) Gas Co.; Chester L. May, Lone Star Gas Co., Dallas, all directors.

Robert W. Otto, Laclede Gas Co., St. Louis; F. T. Parks, Public Service Co. of Colorado, Denver; J. C. Peterson, Manufacturers Light & Heat Co., Pittsburgh; W. F. Rockwell Jr., Rockwell Manufacturing Co., Pittsburgh; Edward H. Smoker, United Gas Improvement Co., Philadelphia; J. Theodore Wolfe, Baltimore Gas & Electric Co., all directors.

D. K. Yorath, Northwestern Utilities Ltd., Edmonton, Alta., director; E. R. Eberle, Public Service Electric & Gas Co., Newark, N. J., chairman, accounting; J. H. Carson, East Ohio Gas, Cleveland, chairman, general management section; L. E. Biemiller, Baltimore Gas, chairman, industrial & commercial; J. H. Collins Sr., New Orleans Public Service Inc., chairman, operating; B. H. Wittman, Peoples Gas Light & Coke Co., Chicago, chairman, residential.

W. D. Sweetman, Peoples, Chicago, vice chairman, accounting; L. A. Brandt, Peoples, Chicago, vice chairman, general management; J. R. Delaney, Cincinnati Gas & Electric, vice chairman, industrial and commercial gas; Grove Lawrence, Southern California Gas Co., Los Angeles, first vice chairman, and V. F. Bittner, Peoples, Chicago, second vice chairman, operating; W. D. Williams, New Jersey Natural Gas Co., Asbury Park, vice chairman, residential.

Unique AGA-PCGA convention to meet in L. A.

SOME 3000—or more—delegates are expected to make the long trip west for the thirty somethingth annual convention of the American Gas Association in Los Angeles this month, Oct. 17-19. This convention will be unique, not only in its location but in the fact that it is to be held jointly with the Pacific Coast Gas Association's 62nd annual meeting.

For the occasion, PCGA has stepped down to make room for the national association, compressing its own convention into a single luncheon on the last day. However, westerners have been in the saddle on convention arrangements. Vice President Robert A. Hornby of Pacific Lighting Corp. has carved out the program. Vice President R. R. Blackburn of Southern California Gas Co. has headed the general convention committee, and the arrangements have been composed exclusively of westerners.

As always, this year's convention will have parallel sessions going on in many places simultaneously. Afternoons will find the accounting, operating, industrial and commercial gas, residential gas, home service, and general management groups in meetings in the three convention hotels, the Biltmore, Statler, and Ambassador. Mornings, however, have been reserved for general sessions, all of which will convene at 10 a.m. in the Pacific Ballroom of the Statler hotel. Two luncheons will be held Monday, one a joint affair for the sales sections, the other a general management section affair. Tuesday's single luncheon will be for the accounting section. Wednesday noon's feature will be the combined PCGA convention-general convention windup luncheon.

Evenings will be taken up with the president's reception and dance on Monday and the trip to Disneyland on Tuesday. No evening events are planned for Wednesday since the convention will be winding up in the early afternoon.

F. M. Banks, president of Southern California Gas Co., will be bowing out as AGA president at the close of the convention.

Featured speakers at the general sessions will include J. Ed Warren, vice president of the First National City Bank of New York, on "Whats and Wheres of Our Energy Needs and Supplies"; T. T. Arden, GAMA president and vice president of Robertshaw-Fulton Controls Co., on "The 'New Look' at Gas Appliances (With No Apologies to Mr. Dior)"; L. C. Lockley, dean of the University of Southern California's School of Commerce, on "Future Buying Habits of the American Public"; and John C. Merriam, president of Northern Natural Gas Co., on "The Natural Gas Industry."

Timely subjects to be explored by the accounting section include management of costs, electronics, employee relations, accelerated depreciation, and methods and procedures work.

The industrial and commercial gas section will inquire into the threat of atomic energy as a fuel, methods of integrating local with national sales, and ways of selling dynamically.

The residential section will be treated to such unusual presentations as "A Tale of Two Kitchens," a househeating skit titled "Hey Charlie," a feature on gas all-year air conditioning, and a report on the "action" program. At the joint luncheon of the two sales groups, Mrs. America will be introduced.

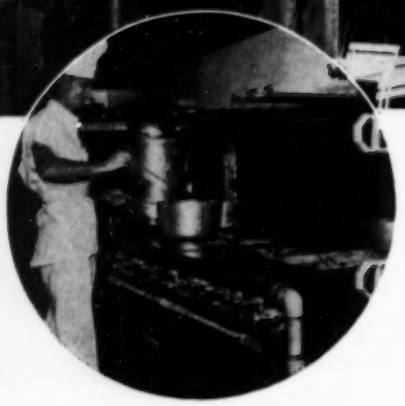
Home service ladies are cooking up an outstanding breakfast for 8 a.m. Tuesday to be served at the Ambassador along with a skit put on by the home service department of Southern California Gas Co. Home laundries and rotisseries will come in for special attention at the afternoon round table.

In the operating section, topics will include economics of gas distribution, quality control, telemetering and remote control, safety, underground storage, and corrosion engineering.

The general management section has scheduled a talk by a financier, a study of paperwork reduction, and a report on the atom blast.

Probably only gasmen would think twice about the importance of their favorite fuel in making Disneyland, Calif., colorful and comfortable. But this month, AGA delegates will have the opportunity to see the evidence first hand when they visit the fabulous playground for the big convention barbecue.

Two sides to the unique Pavilion restaurant in Disneyland are indicated. On one side, facing Adventureland, the restaurant represents a Samoan hut. On the other side, facing the Plaza of turn-of-the-century America, the gas-equipped restaurant resembles Gay Nineties architecture.



Chef Terry of the Pavilion restaurant happily cooks on a gas range.

Gas plays important role at Disney's "dream world"

As wondrous as the make-believe of Disneyland is the ubiquitous behind-the-scenes efficiency of gas, the ability of which to make people comfortable—even amidst the hectic atmosphere of a giant amusement park—was never better demonstrated than it is each day in Walt Disney's Anaheim (Calif.) dream world.

Nor is natural gas always behind the scenes. One of the first sights which has greeted more than 20,000 visitors who have come to Disneyland each day since its opening on July 18 has been Main Street, U.S.A., a reproduction of turn-of-the-century days which is studded with gas lights.

Another, and more unusual, role for natural gas in the park is its use in conjunction with the "freight" train, the scaled down version of an old-time cap-stack "iron horse," which takes off from Frontierland for a passenger-laden ride around the perimeter of the entire

grounds. The train is drawn by a diesel-fired steam engine, and natural gas is used every morning to fire the engines for the day's first run.

Frontierland is one of four sections of the giant amusement park. Others are Fantasyland, Adventureland, and Tomorrowland.

But natural gas' most predominant role is its use as a fuel for cooking, heating, and maintaining of the many vital functions of Disneyland.

There are 20 restaurants, sandwich counters, and specialty houses which offer food to the throngs of Disneyland visitors. And natural gas serves them predominantly.

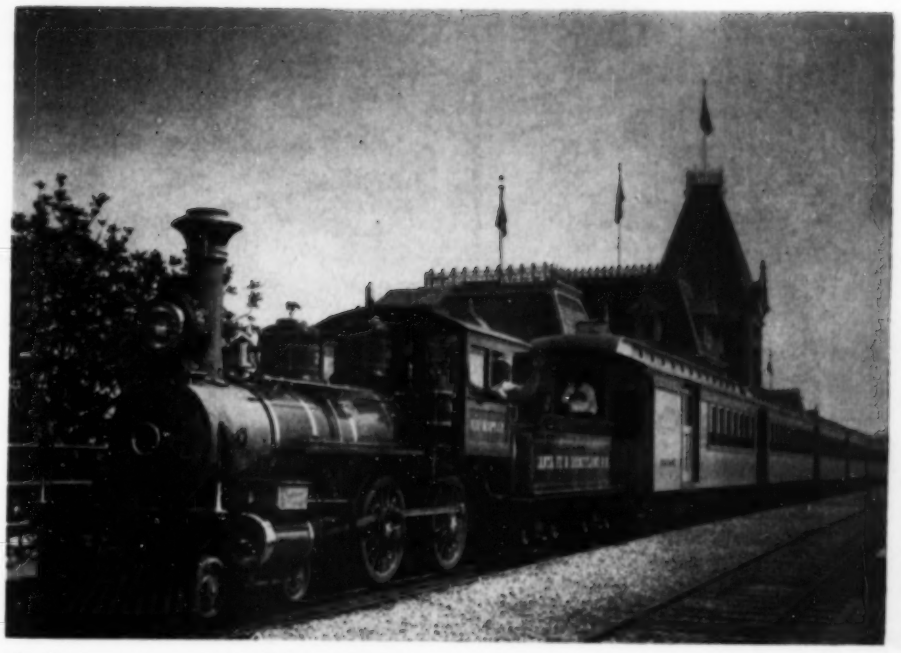
Gas consumption

So predominantly, in fact, that in the first full month—Aug. 2 - Sept. 1—following its opening, two large Southern Counties Gas Co. meters—a No. 5 Emco and an 80-B Metric—registered 1,036,000 cu ft of natural gas consumed in Disneyland.

They serve the miles of house lines which cover almost all of the 160-acre park.

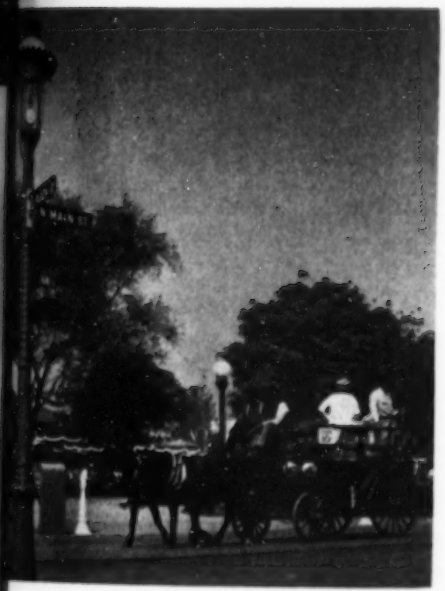
Officials of Southern Counties, which serves Disneyland as one of its more than 490,000 consumers, estimate its gas consumption during August would have been enough to satisfy one day's needs of all general service customers in a town like Culver City, for example.

And it should be noted not all Disneyland restaurants are open for business at this time. Some are still being fitted out.



Ready for another round is Chief Engineer H. W. Ilgen of the Santa Fe and Disneyland railroad, which circles the Anaheim amusement park. The diesel is fired up each morning by gas.

Old-time elegance is exemplified by Disneyland's Red Wagon Inn, which features complete luncheon and dinner menus served in a setting of early day graciousness patterned after such models as Delmonico's in turn-of-the-century New York. The kitchen of the inn is gas equipped.



Brighter than day is the length of street known as Main Street USA in Disneyland. Old-time stores, parks, horse-drawn trolleys, and buckboards are lit nightly by the brightness of real gas lamps.

Big investment

An estimated $50,000 has been invested in commercial gas cooking equipment in Disneyland.

Restaurants, now open, using gas equipment include two in Fantasyland, one in Frontierland, Aunt Jemima, the Plantation, the Space Bar, the Yacht Club, the Puffin Bake Shop, the Red Wagon, and the Pavilion.

The Red Wagon and the Pavilion both front on the Plaza, which is the hub of the four lands." The Red Wagon is a recreation of the Gay Nineties restaurant typified by Delmonico's in Old New York. The Pavilion, also known as the Buffeteria, is a new concept in food service, combining the better features of buffet, cafeteria, and restaurant.

Among them these restaurants use equipment which is representative of nearly all manufacturers of commercial gas cooking equipment.

In addition equipment for space and water heating throughout Disneyland is predominantly gas-fired. ■

PART 2 OF A 3-PART ARTICLE

Protective security measures for the gas industry

Systems to be established

1. *A clearly defined perimeter barrier.*
2. *A personnel identification and control system.*
3. *Automatic alarm system for vital points of access or egress.*
4. *Protective lighting as considered desirable.*
5. *Escort procedures.*

PROTECTIVE measures include all actions, measures, and techniques employed to protect the personnel, products or service, premises, and processes of the gas industry.

In determining what protective measures shall be taken to protect gas facilities, the following points should be evaluated:

1. The imminence of the hazard.
2. The probable or calculated loss.
3. Compromise of security vs efficiency.
4. Practical limitations imposed by the physical characteristics of the system or facility.
5. Availability of capital.
6. Evaluation of potential damage.
7. Measures necessary to direct and control the security program.

The scope and character of a protective program should be no more extensive and no more limited than is warranted by a careful evaluation of the above considerations. It must not be forgotten that the criticality of a system may vary from time to time as its products or services become more or less essential to the national defense emergency, or its share of the total nation's production becomes greater or lesser. Also, the importance of a system or facility does not necessarily depend upon whether it is producing an end product.

The general security measures outlined in "Security Principles for the Petroleum and Gas Industries" are intended to serve the following purposes:

1. Provide a basis for planning and implementing protective programs.
2. Provide a basis for evaluating protective programs.
3. Achieve greater uniformity in protective programs.
4. Achieve greater consistency between protective programs.
5. Avoid excessive protective measures.
6. Provide more specific security guidance and assistance to management.

Perhaps the first consideration in any security program is the safeguarding of vital areas or facilities. Segregation or compartmentation may be accomplished by establishing restricted areas. It must first be determined which areas or which facilities constitute critical areas. The individuals requiring access to these areas should then be decided upon. A study should be made to learn to what degree efficiency will be impaired by establishing various areas as restricted. Also, existing fences, barriers, etc., should be surveyed to ascertain their usefulness in establishing restricted areas.

The protective organization for a gas system or facility will depend almost entirely upon the size, criticality and vulnerability, the number of the system's personnel, and the added cost that may be assumed for this operation. Such an organization requires complete coordination between management and workers, and between the system or facility and the community and government.

The proper discharge of the protective organization's functions, as well as the vital importance of the matter to management and workers, requires that the responsibility for protection be placed in a position of top level authority so that safety and security problems will receive equal consideration with production, sales, and other management functions.

The complexity of the problems of protection clearly points to the necessity for delegating to one individual the responsibility for protection operations. Whether the assignment of this individual is full or part time depends upon the size and nature of the system or facility.

Personnel

Employees are in a very favorable position for the accomplishment of espionage and sabotage. Since applicants may become employees, and since employees are in this favorable position, care should be exercised in the screening, investigation, and clearance of personnel.

There are five general categories of potentially undesirable applicants or employees in addition to the known subversive, namely:

(1) One susceptible to recruitment by subversive elements.
(2) Habitually dissatisfied or disgruntled employees.
(3) Individuals exhibiting habitual criminal tendencies.
(4) Accident prone or careless individuals whose acts or failure to act may have the same results as an act of sabotage.
(5) Absentees.

Criteria to be applied to eliminate undesirables from the standpoint of security are discussed at length under the section on Personnel Loyalty Determinations, Part VIII.

When it becomes necessary to establish restricted areas, a system controlling access to them is required. The control system employed should:

1. Provide a means of identifying personnel who are authorized to have access.
2. Facilitate control of the admission of personnel.

3. Facilitate control of the egress of personnel.

4. Provide a visible means of easily recognizing any limitations or access within restricted areas.

Sections detailing the pass and badge system, employee identification and control system, and visitor identification and control system are found in Part VIII of "Security Principles."

Another section of Part VIII deals with safeguarding classified security matter. Classified security matter is information, data, documents, material, products, etc., which must be safeguarded in the interest of national security. Security matter should not be confused with matter such as personnel records, high level company decisions, unpatented processes, etc., which are given a confidential classification by management for purely administrative reasons.

The term, safeguarding, includes care in production, transmission, handling, disseminating and storage, and stages of an operation to assure that unauthorized individuals do not have access to classified security matter.

Security classifications commonly in use are "Top Secret," "Secret," or "Restricted," depending on the degree of importance to the national security. "Top Secret" covers matters of utmost importance. "Restricted" requires the minimum of precaution.

Besides organizing a security program within its own company, a gas utility should establish a working relation with the activities of those federal, national, state, local, and private associations and organizations concerned with security.

Emergency and disaster plans should be coordinated with state and local Civil Defense agencies and military authorities so that there will be complete understanding concerning relative spheres of activity during an emergency or disaster, thereby avoiding duplication of effort. Particular attention should be given to permitting the movement of essential personnel and equipment during emergencies.

The formulation, activation, and application of protective measures for any gas system or facility is the responsibility of the employees as well as of management. Operating personnel are in an excellent position to plan and implement those measures essential for security.

There should be a clear line of responsibility in each gas system or facility from the chief executive to the manager or supervisor in charge of each property that is to have defense protection of its facilities. Each manager or supervisor should be given appropriate authority to adopt such protective measures as may be necessary to discharge his responsibility, especially in event of an emergency.

Management should perform frequent inspections and receive reports to assure itself of the sufficiency of the security programs. This procedure will be of assistance in maintaining the efficiency and continuity of the security program and providing revisions as required by changing conditions, as well as creating and maintaining interest.

When it is necessary for authorized governmental agencies to make a security inspection, they should first arrange with top management to review the over-all program and decide on such facilities as should be inspected. The inspector should be accompanied by a representative of top management.

Any reports prepared by the inspector should be in cooperation with top management, which should be furnished with a copy.

In analyzing the need for and the type and extent of the industrial security measures required at a facility, the following factors, among others, should be considered in planning an industrial security program:

1. The classification of information, data, activities, and/or strategic value of matter located therein.

2. The importance of the facility to the continuity of essential production or service operations. (In evaluating this factor, the availability of alternate facilities that could be utilized in an emergency, and/or the availability of stockpiles of materials produced by the facility under consideration should be analyzed.)

3. The vulnerability of vital equipment or materials to damage or theft.

4. The location, size, and arrangement of the facility, and numbers of personnel involved.

5. The need for integrating adequate security measures with operating requirements, and other local considerations.

6. The probable duration of operations.

7. The possibility or probability of expansion, retrenchment, or other changes in operation.

8. The cost of alternate methods of providing adequate protection.

9. After analysis and evaluation of these and other pertinent considerations, a physical security program should be designed in accordance with measures hereinafter set forth.

The maintenance of a guard force is frequently necessary. In determining the need for a guard force in the security program for a facility, all factors bearing on the security interest at such a facility must be considered, as well as conditions relating to the nature, and layout of the facility and the incorporation and effectiveness of other elements in such a program. As these factors may differ widely in individual cases, it is not possible to prescribe criteria that will specifically fit each situation.

Guard forces are required for all restricted areas. The need for guards is roughly in proportion to the scope of activities, the numbers of personnel involved, and the size of the facility concerned. As these factors increase, the safeguards provided by individual employees tend to decrease, resulting in the need for a guard force to control access to the restricted area involved. Guard forces are seldom required at facilities of individual consultants and small laboratories involving only a few individuals. The security interest at such facilities usually consists of docu-

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Functions to be provided by protective organization include:

1. Analyze the criticality and vulnerability of the system or facility and community to determine how great are the hazards and where the hazards are most likely to develop.

2. Analyze the existing protective system to determine the adequacy of the system in the light of hazards involved, and to establish such additional protective measures as may be necessary.

3. Train employees to observe protection regulations and to understand the reasons and purposes of the various regulations.

4. Train key personnel in protection functions so that they may organize and direct workers under them in emergency.

5. Establish and maintain cooperative procedures between management and workers to secure suggestions and information from workers, assign protective responsibilities, and aid in the harmonious and efficient operation of the program.

6. Establish coordinated working relationships with the entire community civil defense organization.

Protective security... An effective protective communication system is necessary

ments or materials of such type and amount as to be adequately safeguarded by appropriate depositories and by personal custody of cleared personnel utilizing such matter in the performance of their work.

Such subjects as guard qualifications, selection, training, and equipment are detailed in Part VIII.

Supplementing actual guard forces are fencing and other anti-personnel barriers. These are used to physically define restricted areas for protection and for control. The fundamental purpose of physical barriers is to deny or impede access to security areas by unauthorized persons. They accomplish this by both physical and psychological means.

Physical barriers that are as man-proof as economically feasible should be established around all restricted areas. The type of barrier used should be determined after a study of local conditions. Natural barriers, including rivers, cliffs, canyons, etc., should be taken advantage of when outlining restricted areas.

In establishing physical barriers, special consideration must be given so that operating efficiency will not be sacrificed through lack of planning and essential barriers will not be sacrificed for operating expediency.

Protective lighting represents another industrial security measure. The determination as to the necessity for protective lighting depends upon many considerations such as:

1. The military policy toward blackouts and dimouts.
2. The location of the facility.
3. The size, type, and character of the facility.
4. The advantages afforded which may result in a reduction of the number of guards needed.
5. The advantages protective lighting affords in unguarded, isolated facilities by providing an increasing possibility of observation from highways, water approaches, etc., by local law enforcement officials, the general public, and periodic car patrols.
6. The availability of protective lighting materials and equipment.
7. Management policy.

Protective alarm systems fall in the same general category as protective lighting. They provide an electrical and mechanical means of detecting and announcing proximity or intrusion which endangers or may endanger the security of a restricted area, a facility, or its components. Protective alarm systems are utilized to accomplish one or more of the following purposes:

1. To permit more economical and efficient use of manpower by substitution of mobile responding guard units for larger numbers of fixed guards and/or patrols.
2. To take the place of other necessary elements of physical security which cannot be used because of building layout, safety regulations, operating requirements, appearance, cost, or other reasons.
3. To provide additional controls at vital areas as insurance against human or mechanical failure.

To tie together the various protective systems, an effective protective communication system is necessary. (See box on page 85 for its functions.)

Fire protection is tied in with protective measures because fire is the greatest single destroyer of property, and also one of the saboteur's handiest tools. A substantial fire risk is inherent in practically all forms of the gas industry. Even in World War II, when tremendous emphasis was placed on keeping facilities or systems operating, fire caused a great amount of damage.

The advice of an expert on fire protection should be sought if an expert in this field is not already a part of the facility staff. In general, interruptions in production or service and destruction from fire can be prevented through good housekeeping, division of values, adequate physical barriers to prevent the spread of fire, and the elimination of fire causes. Ample fire first-aid, and manual and automatic fire control and extinguishing equipment where products or process materials are combustible, are vital. In addition, the organization of a system or facility fire brigade, the establishment of a fire alarm service, and the assurance of a thoroughly reliable and adequate water supply are essential.

An adequate safety program might also be listed as a protective measure. In addition to the humanitarian aspect, injuries to personnel result in serious delays in production, destroy morale, and are expensive in time, money, and man-power. The great majority of accidents in the gas industry occur because employees violate common accident rules or assume unwarranted personal risks. Mechanical safeguarding of physical hazards, while necessary and important, can accomplish only a small degree of personal injury reduction, unless it is a part of a constant campaign aimed at inspiring the individual to safeguard his own personal welfare. In any safety program, aggressive efforts must be made to advise practical meth-

In analyzing the need for and the type and extent of the industrial security measures required at a facility, some factors that should be considered:

1. The classification of information, data, activities, and/or strategic value of matter located therein.

2. The importance of the facility to the continuity of essential production or service operations. (In evaluating this factor, the availability of alternate facilities that could be utilized in an emergency, and/or the availability of stockpiles of materials produced by the facility under consideration should be analyzed.)

3. The vulnerability of vital equipment or materials to damage or theft.

4. The location, size, and arrangement of the facility, and numbers of personnel involved.

5. The need for integrating adequate security measures with operating, requirements, and other local considerations.

6. The probable duration of operations.

7. The possibility or probability of expansion, retrenchment, or other changes in operations.

8. The cost of alternate methods of providing adequate protection.

9. After analysis and evaluation of these and other pertinent considerations, a physical security program should be designed in accordance with measures hereinafter set forth.

ods of creating safe working habits on the part of all employees, and a positive will to abide by safety procedures.

There are several items that might be listed under miscellaneous considerations. For example, there should be a definite system of truck control in use to limit and control the movement of trucks and other goods' conveyances into and out of the facility area. Insofar as possible, loading and unloading platforms should be located outside restricted areas.

The movement of railroad cars into and out of restricted areas should also be so supervised as to prevent the entry of unauthorized personnel or goods. All railroad entrances to restricted areas should be controlled by locked gates when not in use, and should be under guard supervision when either unlocked or opened for passage of railroad cars.

Management of each facility should consider establishing a definite system for the control of containers entering or leaving the restricted area. Such control should be desirable as an effective means of preventing possible sabotage.

Normally, employees and visitors should not be permitted to park their automobiles within the restricted area. If it is found impractical for all cars to be parked outside of the restricted area, then only employees should be allowed to park within the enclosure. In case of interior restricted area parking, the parking area should be located away from important processes and separately fenced in such a manner that occupants of automobiles must pass through a pedestrian gate before entering the facility.

Transformer installations, because of their importance to continuity of production or service, are especially vulnerable to sabotage. Their protection should be carefully studied, and all reasonable methods of protection applied.

Power lines, power terminals, and power switches and controls located within the facility perimeter should be provided adequate protection to assure continuous and uninterrupted flow of electric energy to protect the plant.

Main control valves, regulators, and regulator stations are all vulnerable components of a gas system, and require protective measures. All should be protected to prevent tampering and unauthorized manipulation, but should be accessible to authorized personnel.

Main shutoff and control valve locations should be restricted areas, and should be enclosed. If exposed, such valves should be locked in the position required for normal operations. Manholes and pits containing control valves should be secured by covers locked in place. Equipment or control valves with electric signalling devices should be considered for additional protection against tampering.

Gas valves and regulators should be within a noncombustible locked enclosure, adequately ventilated to prevent accumulation of gas and provided with vapor-proof or explosion-proof electric equipment. Gas valves used infrequently should be locked or sealed. Guards should check the enclosures and the valves and regulators periodically.

Water tanks, water pumps, and allied equipment essential to the operation and production of the facility should be afforded adequate protection to prevent curtailment, contamination, or damage to the water supply.

The responsibility for active defense against overt enemy attack rests with the military. Passive defense measures, the job of all members of the gas company, embrace those precautions taken in connection with the construction, design, and layout of buildings which will afford to personnel and equipment protection against such destructive forces as blast, fragmentation, radiation, and other effects of enemy air attack. These measures include dispersion, duplication, camouflage, personnel shelters, underground construction, and similar measures designed to minimize casualties and damage to equipment. They vary in degree of protection and are necessarily limited by the importance of the facility and economic factors. Studies of the system or facility will determine the items which are most vulnerable to various types of attack.

An essential part of any protective program are measures to minimize the effects of enemy attack. These measures are similar to civil defense services now being established in communities throughout the country. It should be recognized that in a large scale disaster, the demands upon civil defense and other community services will be so great that each gas system and facility must be prepared to do its utmost to protect itself. Each system and facility, therefore, should establish a self-protection program with the aim of reducing losses to personnel and equipment in the event of enemy attack. In view of this, gas system employees should not be committed other than in the capacity of consultants, to outside civil defense organizations unless their services are not required in the self-protection program. Civil defense starts in each system or facility, and outside help should be summoned only when the disaster is beyond the capabilities of an individual system or facility. When outside assistance is called, it should operate under the direction and supervision of qualified employees.

These measures to deal with emergency situations can be established in all gas installations, regardless of size or type, at no substantial cost and require no additional personnel. Present personnel are formed into groups and trained to perform under the direction of the security director in specialized services, such as fire-fighting, engineering services, rescues, and first-aid to safeguard the facility and its occupants in time of disaster. ■

To tie together the various protective systems, an effective protection communication system is necessary. It should:

1. Provide the means for expeditious transmission of reports and instructions between guard headquarters, guard posts, and guard patrols both as a matter of routine and as a matter of emergency necessity.

2. Facilitate the integration and coordination of the guarding function.

3. Facilitate the efficient and economical utilization of guard forces.

4. Insure expeditious transmission of requests for assistance to outside sources in the event of an emergency beyond the capabilities of the guard force.

5. Provide for the transmittal of alarm signals to facility guards or to outside sources of response.

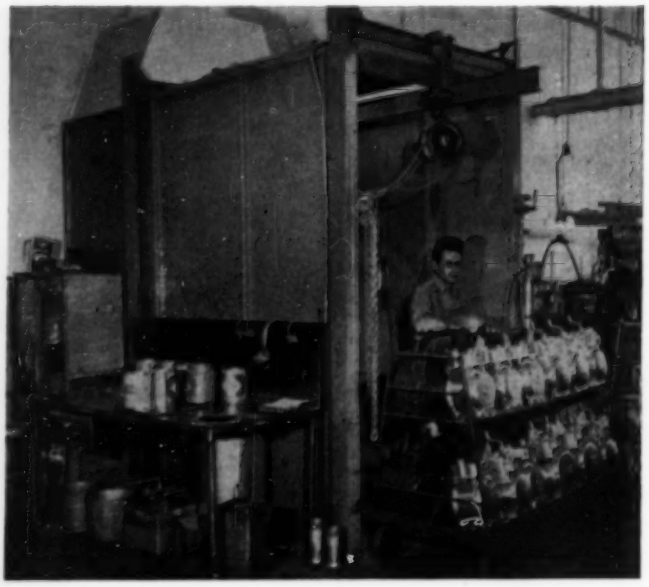
Next Month

In Part 3, check lists for petroleum or gas system and facility security inspection will be presented.

Part 1, in the September issue of GAS, covered general security principles for the gas utility.

Painting is done in a DeVilbiss water-washed, air-system, spray booth that is equipped with a 34-in. top exhaust outlet, a water tank with a capacity of 226 gal. for the washed air system, and an overflow sump and filtering system. It has a pneumatic safety switch system, non-tilting turntable, ½-ton overhead trolley hoist for large meters, and fluorescent lights located in the top of the booth. The lights are protected by tightly sealed glass enclosures. The spray gun can only be operated while the fan is running. When the air is turned on for spraying, the exhaust fan and water pump start automatically. This arrangement assures proper ventilation at all times and prevents accumulation of vapor in the booth. It is not necessary for the operator to wear a mask. Thirteen ounces of Wyandotte is put in the water to float the paint that gets into the tank from the spray gun. The paint is skimmed off every day. Once each month, the water is changed and the booth is subjected to a general cleaning. For its conditions, Public Service found that a primer should be sprayed, especially on the iron-case meters, before the aluminum paint is applied. Appoximately 100 meters a day can be painted with these two applications.

This meter bench vise was constructed by PSC's gas shop department. It is a squeeze connection, operated by a Hanna plug valve operator cylinder under 100 lb of air pressure. It holds the meter in a rigid position for the repair work.



METER SHOP GADGETEERING

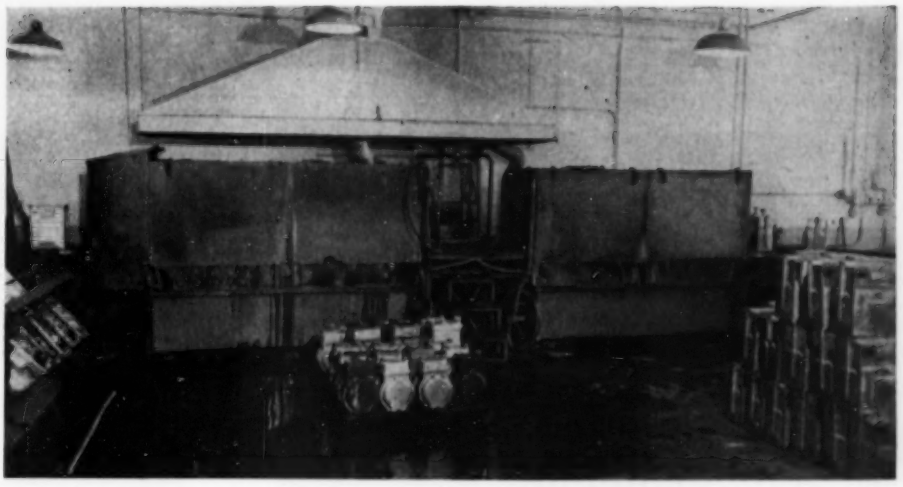
By A. H. TILTON, Gas Meter Shop Supervisor
Public Service Co. of Colorado, Denver

AT our meter shop, we have attempted to develop methods and devices that will do a good job under the day-to-day operations governed by our local conditions. We have a good meter shop — we don't claim to be the world's best or the most highly mechanized shop, but we have bought and built some "gadgets" that have demonstrated their ability to help us increase our productivity at reasonable costs.

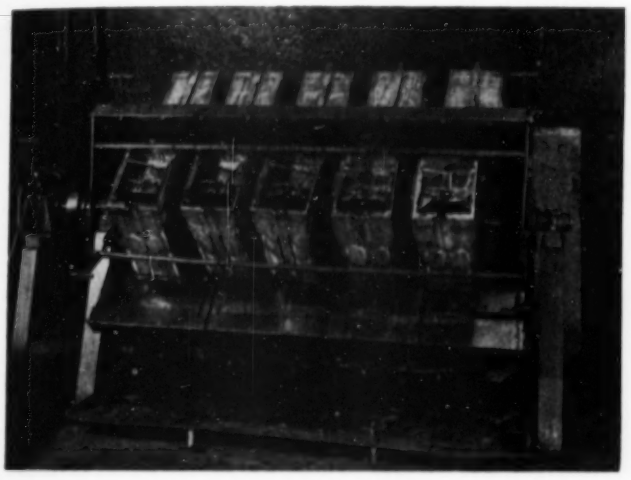
Probably experienced meter shop men will find none of these devices pictured sensational, but many of these individuals will recognize that all of them are *practical* approaches to the current trend toward automation and efficiency.

Meterman spray-painting ironcase meter in the water-washed spray booth. The water curtain in the rear scavenges paint blow-by from spray gun. Note the handy index glass blanking device and the rotatable painting table.

The old and new company number attachment method, pointed out here by a PSC employee, was put into use last year. The new number (on the right) stamped on a ½- by 4-in. brass tape with an appropriate initial to designate the division, is riveted to the lower part of the index box. The index reading and the company number can be checked much easier than formally when the number was soldered on the front case. The new method was adopted when it was discovered that acid used to solder the number caused rust and discoloration. Only two operations, instead of five, are now required to attach the number to the meter.



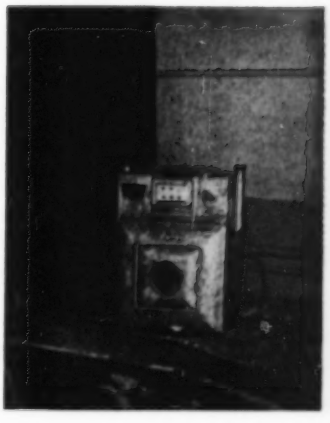
Meter washer and rinse machine (upper right). Each tank has a capacity of 400 gal. of water. The meters are rolled into the washing machine on a conveyor that extends from the proving room. The water in the washing machine is charged with 125 lb of caustic soda. This usually lasts between two and three months. At times it is necessary to add some caustic soda to keep the water up to its proper concentration, depending, of course, upon the number of meters that are washed each month. The meters travel on a conveyor through the washing and rinsing machine. Each machine is equipped with 28 spray nozzles, separate pumps, and submerged burners. The water is forced through the nozzles at 20 psig at a temperature of 185° F in the wash tank, and 145° F in the rinse tank. Water temperature is thermostatically controlled. The conveyor travels approximately 24 ft, and a meter can be washed and rinsed in 17 seconds. All fumes are vented to an overhead canopy that is serviced by an exhaust fan located in an opening in the roof.



Meter diaphragm oiling machine, designed and built in the PSC shop, will oil approximately three times the number of meters that were done under the old system. Thirty minutes is required for a complete application of oil. During this time, the meter turns over 45 times in a slow rotation, which allows the oil to penetrate over the entire surface of the diaphragm. This machine is used for tin case meters only. The load capacity is as follows: 20 5-lt tin case meters with front and back covers; 24 5-lt tin case meters without covers; 16 10-lt tin case meters with front and back covers; 20 10-lt tin case meters without covers. Motor description: Janette a.c. motor, type SSK-16, with Janette speed reducer. Rpm ratio: 1725 to 1.5.

Meter before entering washing and rinsing machine (left).

Meter after it has been washed and rinsed (right).



GAS exclusive

Fig. 1. Boot being slipped back on service pipe before welding pipe to tee.

Fig. 2. Boot being pulled over service tee.

"Boot" wrap for service tees devised by SoCal engineers

By S. K. GALLY

and C. E. LEE

Southern California Gas Co.

Los Angeles

THE pressure-sensitive plastic tapes are one of the most interesting recent developments in pipe coating. They—along with the hot-applied tape wrappers—have quickened the interest of many people in the abandonment of the "tar pot" for field pipe wrapping.

Laboratory tests

Southern California Gas Co. has been running laboratory tests on these tapes, subjecting them to a number of tests in which both the polyvinyl chloride and polyethylene tapes have performed well when applied over the clean, primed surface of a straight piece of pipe. Unfortunately, it has not proved possible to make a completely watertight wrap with plastic tape over a service tee, one of the most common fittings, or in fact, over other fittings of irregular shape.

After trying various tape-wrapping techniques on service tees without success, it was decided that the most promising way to achieve complete coverage was to use a one-piece flexible covering, or "boot," for the irregular shaped portion.

The materials that seemed best suited for the manufacture of boots were vinyl plastisols, since they are durable, strong and low in cost.

Applications

Vinyl plastisols are used for acid tank lining, electro-plating rack coating, and in many other applications where corrosion is a problem. A plastisol consists of a dispersion of vinyl resin in a plasticizer. Typically, they are syrupy, black liquids, which are converted to a tough, rubbery plastic by the application of heat to the mold.

Fig. 3. Wrapping the main with tape.

Fig. 4. Wrapping the service with tape.

Vinyl resins themselves are known to be durable underground. The resistance of the boot to deterioration depends on the plasticizer and other additives. Compounds designed especially for underground service can be formulated.

Installation of boot

The installation of a boot on a service connection is shown in the illustrations. In *Fig. 1*, the boot is slid back on the service pipe before the pipe is welded to the tee. *Fig. 2* shows the boot being stretched over the tee. The flaps of the boot encircle the main so that only one joint in the boot remains to be sealed with tape. *Figs. 3* and *4* show the tape being applied to the main and the service, while *Fig. 5* shows the completed joint. This boot is made to cover either a weld tee or one with a coupling outlet.

The boot principle has also been applied to compression couplings as shown in *Figs. 6* and *7*. Here the boot is made in two halves, which are joined in the center by tape.

Soil burial

Service connections and couplings protected with plastic boots and tape have passed successfully a variety of laboratory tests, including prolonged soil burial.

The opportunity has not arisen to give these boots tests under field conditions. It appears, however, from the experimental work, that the "boot" principle and vinyl plastisols may have considerable value in protecting buried fittings from corrosion. ■

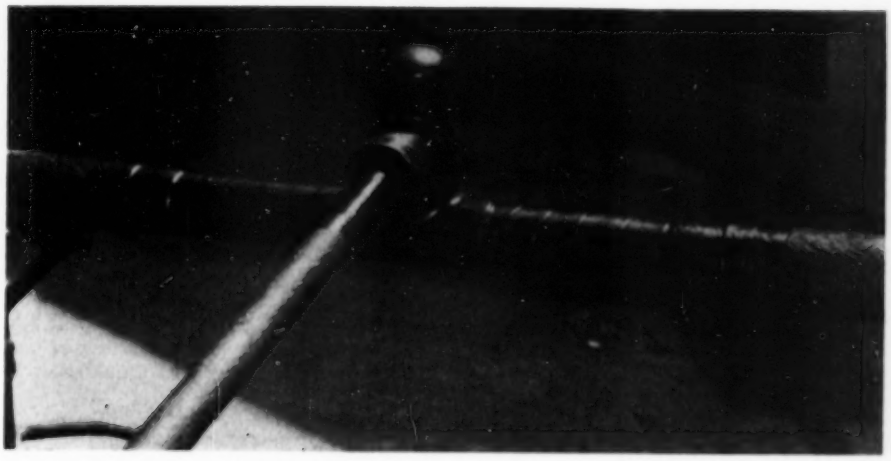


Fig. 5. Completely protected service connection.

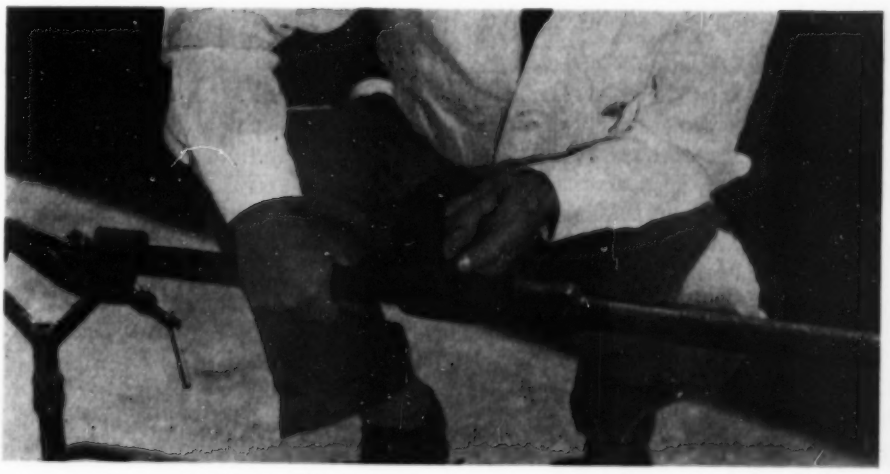


Fig. 6. Installing boot halves over compression coupling.

Fig. 7. Completing wrap of compression coupling.

Manufacturing rights for this boot have been assigned to the Dresser Manufacturing Division of Dresser Industries Inc. by the authors (also the developers) by agreement with Southern California Gas Co.

Computer prepares tables of supercompressibility factors

By E. R. GRIFFITH, Research Engineer
American Gas Association, New York

ELECTRONIC computing made possible the publication of the newly released American Gas Association "Tables of Supercompressibility Factors For Natural Gas," to meet the spring 1955 deadline set up by the committee in charge of the project. The AGA called on the Remington Rand Univac to compute and prepare the operating tables of supercompressibility factors, based on a method of evaluation presented in the new AGA Gas Measurement Committee Report No. 3, "Orifice Metering of Natural Gas." The new tables, according to the association, "will provide the gas industry with expanded, error-free operating tables of compressibility factors and will eliminate errors and differences in interpolation and rounding when using less extensive tables."

From 1935, when the AGA Gas Measurement Committee Report No. 2 was published, until the present time, that report had been the widely accepted technical basis in the United States for essentially all large volume natural gas measurement with orifice meters. During this 20-year period, the methods outlined by the report had been used without major revision.

A few years ago, a movement was started among gas measurement men to review the story of gas measurement and to see if Report No. 2 could be supplemented with other material. From the years of practical experience in orifice metering and through experimental test programs, it was felt that information could be obtained that would be valuable in adding to, as well as revising the report. Because of the development through the years of new metering equipment and the requirement of handling larger volumes of gas at increasingly higher pressures, it was becoming necessary to expand the report to cover these changes.

Inasmuch as the Report No. 2 did not include a method of evaluating supercompressibility factors without actually making determinations of the deviation from the ideal gas law over the range of flowing pressures and temperatures involved, a group of seven companies in the gas industry sponsored a project supervised by Prof. Samuel R. Beitler at Ohio State University. This project was to develop a method of evaluating supercompressibility factors for natural gas without making separate laboratory determinations. This method developed by this project was reported to the sponsoring companies in "Report on the Study of Supercompressibility Factors for Natural Gases, Including Tables, June 1954." The sponsors released the results of this project to the association for inclusion in the AGA Gas Measurement Committee Report No. 3.

The operating tables of supercompressibility factors, with nearly 2 million entries involved, are being published by the association in seven volumes, with six volumes for hydrocarbon gas supercompressibility factors, each volume covering a pressure range of 500 psig. A seventh volume is to be released for gases having carbon dioxide and/or nitrogen contents within the range 0 to 0.5 and 0 to 12.0 mol % respectively.

If the tables were to be released as originally planned in the spring of 1955, time was of the essence in compiling them. It was a gigantic task to compile and prepare the nearly 4000 operating tables of supercompressibility factors. Of prime consideration was the absolute accuracy required for every figure in these tables.

Even with the basic method available of evaluating supercompressibility factors developed by Professor Beitler, the mechanical means usually employed to produce such tables would require endless hours of computation, with little assurance of absolute and complete accuracy.

Remington Rand's Univac system installations in government agencies and commercial and industrial organizations spotlighted certain outstanding advantages of Univac. Accuracy of computation, equally important as speed, is attained by the Univac system through its careful electronic-circuit designs and its error-detector features built into the system.

The Univac was a "natural" to compute and prepare the 4000 tables of supercompressibility factors; therefore, the AGA turned over to Remington Rand's Electronic Computing Center in New York the basic tables of data to establish the operating tables of supercompressibility factors. With programmers especially assigned to the task, the entire job was completed in record time, with guaranteed accuracy, and at an economical cost.

The output tables from Univac's high-speed printer, which is capable of printing at the rate of 600 lines-per-minute, were photo-offset in reduced size. How these tables are used is shown in *Examples 1, 2* and *3*.

Early this year, GAS stated, "The high-speed electronic computer is a relatively new tool that is revolutionizing engineering methods by freeing engineers from the routine volume mathematical tasks and making possible a form of numerical experimentation never before exploited. They are already an accepted tool of several gas transmission and distribution engineering departments and they have a vast potential for development and application." ■

The examples on pages 91 and 92 show how to use the tables.

• EXAMPLE 1

Conditions:

Specific gravity 0.592
Meter gauge pressure .....1347 psig
Flowing temperature .....143°F

From page III - 127 read the supercompressibility factor for:

Specific gravity 0.592
Meter gauge pressure .....1340 psig
Temperature .....142°F
F_{pv} 1.0527

NOTES:

(1) While the F_{pv} factors given in these tables are to be used directly with differential type flow meters, the factor, $(F_{pv})^2$, is applicable to gas volumes measured with displacement type meters.

(2) $F_{pv} = \sqrt{\frac{RT}{PV}}$

Where:

F_{pv} = Supercompressibility factor:
R = Gas constant
T = Absolute gas temperature
P = Absolute gas pressure
V = Molar gas volume

• EXAMPLES 2 and 3

Conditions:

Specific gravity 0.731
Carbon dioxide content 2.75 mol %
Nitrogen content ..... 6.18 mol %
Meter gauge pressure....1344 psig
Flowing temperature .... 87°F

From Table of Pressure and Temperature Adjustment Factors, page VII - 189 read adjustment factors F(P) and F(T) for:

Specific gravity 0.731
Carbon dioxide content 2.6 mol %
Nitrogen content ..... 6.0 mol %
Pressure adjustment factor .....F(P) = 1.0040
Temperature adjustment factor .....F(T) = 0.9394

Calculate the adjusted pressure and temperature

Adjusted pressure
= Meter gauge pressure × F(P)
= 1344 × 1.0040
= 1349.4 psig
Adjusted temperature
= (Flowing temp. + 460) × F(T)
= 547 × 0.9394
= 513.9 °F absolute

Calculate the adjusted temperature in degrees Fahrenheit

Adjusted temperature
= (513.8 − 460) = 53.8 °F

From Table of Supercompressibility Factors, page VII - 258, read the supercompressibility factor for:

Meter gauge pressure.....1340 psig
Temperature ..... 53 °F
F_{pv} = 1.1201

To work example!

TABLE OF SUPERCOMPRESSIBILITY FACTORS, F_{pv} III-127

APPLIES TO SPECIFIC GRAVITIES OF .588 .589 (.5901) .591 (.592)

METER GAUGE PRESSURE, PSIG	TEMPERATURE, DEGREES FAHRENHEIT									
	140	142	144	146	148	150	152	154	156	158
1000	1.0426	1.0419	1.0413	1.0406	1.0400	1.0394	1.0388	1.0382	1.0376	1.0370
1010	1.0430	1.0422	1.0416	1.0410	1.0403	1.0397	1.0391	1.0385	1.0379	1.0373
1020	1.0433	1.0426	1.0420	1.0413	1.0407	1.0401	1.0395	1.0389	1.0382	1.0376
1030	1.0436	1.0430	1.0424	1.0417	1.0411	1.0405	1.0398	1.0392	1.0386	1.0379
1040	1.0441	1.0434	1.0428	1.0421	1.0415	1.0408	1.0402	1.0396	1.0389	1.0382
1050	1.0445	1.0437	1.0431	1.0424	1.0418	1.0411	1.0405	1.0399	1.0393	1.0385
1060	1.0448	1.0441	1.0435	1.0427	1.0421	1.0414	1.0408	1.0401	1.0395	1.0389
1070	1.0451	1.0444	1.0438	1.0431	1.0424	1.0417	1.0411	1.0404	1.0398	1.0392
1080	1.0454	1.0447	1.0441	1.0434	1.0427	1.0420	1.0414	1.0407	1.0401	1.0395
1090	1.0457	1.0450	1.0444	1.0437	1.0430	1.0423	1.0417	1.0410	1.0404	1.0398
1100	1.0461	1.0453	1.0447	1.0440	1.0433	1.0426	1.0420	1.0413	1.0407	1.0401
1110	1.0464	1.0456	1.0450	1.0443	1.0436	1.0429	1.0423	1.0416	1.0410	1.0404
1120	1.0467	1.0460	1.0453	1.0446	1.0439	1.0432	1.0425	1.0418	1.0412	1.0405
1130	1.0470	1.0463	1.0456	1.0449	1.0442	1.0435	1.0428	1.0421	1.0415	1.0408
1140	1.0474	1.0467	1.0460	1.0453	1.0446	1.0438	1.0431	1.0424	1.0418	1.0411
1150	1.0477	1.0470	1.0463	1.0456	1.0449	1.0442	1.0434	1.0427	1.0421	1.0414
1160	1.0480	1.0473	1.0466	1.0459	1.0452	1.0445	1.0437	1.0430	1.0423	1.0417
1170	1.0484	1.0476	1.0469	1.0462	1.0455	1.0448	1.0440	1.0433	1.0426	1.0420
1180	1.0487	1.0479	1.0472	1.0465	1.0458	1.0451	1.0443	1.0436	1.0429	1.0423
1190	1.0491	1.0482	1.0475	1.0468	1.0461	1.0454	1.0446	1.0439	1.0432	1.0426
1200	1.0494	1.0486	1.0478	1.0470	1.0463	1.0456	1.0448	1.0441	1.0434	1.0427
1210	1.0497	1.0489	1.0481	1.0474	1.0466	1.0459	1.0451	1.0444	1.0437	1.0430
1220	1.0500	1.0492	1.0484	1.0477	1.0469	1.0462	1.0454	1.0447	1.0440	1.0433
1230	1.0503	1.0495	1.0487	1.0480	1.0472	1.0465	1.0457	1.0450	1.0443	1.0436
1240	1.0506	1.0498	1.0490	1.0483	1.0475	1.0468	1.0460	1.0453	1.0446	1.0439
1250	1.0509	1.0501	1.0493	1.0486	1.0478	1.0471	1.0463	1.0456	1.0449	1.0442
1260	1.0512	1.0504	1.0496	1.0489	1.0481	1.0474	1.0466	1.0459	1.0452	1.0445
1270	1.0515	1.0507	1.0499	1.0492	1.0484	1.0477	1.0469	1.0462	1.0455	1.0448
1280	1.0518	1.0510	1.0502	1.0495	1.0487	1.0479	1.0472	1.0464	1.0457	1.0449
1290	1.0521	1.0513	1.0505	1.0498	1.0490	1.0482	1.0475	1.0467	1.0460	1.0452
1300	1.0524	1.0516	1.0508	1.0500	1.0492	1.0484	1.0477	1.0469	1.0462	1.0455
1310	1.0527	1.0519	1.0511	1.0503	1.0495	1.0487	1.0480	1.0472	1.0465	1.0457
1320	1.0530	1.0521	1.0513	1.0506	1.0498	1.0490	1.0483	1.0475	1.0467	1.0459
1330	1.0533	1.0524	1.0516	1.0509	1.0501	1.0493	1.0486	1.0478	1.0470	1.0462
1340	1.0536	1.0527	1.0519	1.0511	1.0503	1.0495	1.0488	1.0480	1.0472	1.0464
1350	1.0539	1.0530	1.0522	1.0514	1.0506	1.0498	1.0491	1.0483	1.0475	1.0467
1360	1.0542	1.0533	1.0525	1.0517	1.0508	1.0500	1.0493	1.0485	1.0477	1.0469
1370	1.0545	1.0536	1.0528	1.0520	1.0511	1.0503	1.0496	1.0488	1.0480	1.0472
1380	1.0548	1.0539	1.0530	1.0521	1.0513	1.0505	1.0498	1.0490	1.0482	1.0474
1390	1.0551	1.0542	1.0533	1.0524	1.0516	1.0508	1.0501	1.0493	1.0485	1.0477
1400	1.0553	1.0544	1.0535	1.0527	1.0518	1.0510	1.0503	1.0495	1.0487	1.0479
1410	1.0556	1.0547	1.0538	1.0530	1.0521	1.0513	1.0505	1.0497	1.0489	1.0481
1420	1.0559	1.0550	1.0541	1.0533	1.0524	1.0515	1.0507	1.0499	1.0491	1.0483
1430	1.0562	1.0553	1.0544	1.0536	1.0527	1.0518	1.0510	1.0502	1.0494	1.0486
1440	1.0564	1.0555	1.0546	1.0537	1.0529	1.0521	1.0512	1.0504	1.0496	1.0488
1450	1.0567	1.0558	1.0549	1.0540	1.0532	1.0523	1.0514	1.0506	1.0498	1.0490
1460	1.0570	1.0561	1.0552	1.0543	1.0534	1.0525	1.0516	1.0508	1.0500	1.0492
1470	1.0573	1.0564	1.0555	1.0546	1.0537	1.0528	1.0519	1.0511	1.0502	1.0494
1480	1.0576	1.0567	1.0558	1.0549	1.0540	1.0531	1.0521	1.0513	1.0504	1.0496
1490	1.0579	1.0570	1.0561	1.0551	1.0542	1.0533	1.0523	1.0516	1.0507	1.0499
1500										

NOTE: EACH HEADING IS INCLUSIVE TO NEXT HIGHER HEADING. DO NOT INTERPOLATE.

To work Example 2

Table of Pressure and Temperature Adjustment Factors VII-189

APPLIES TO SPECIFIC GRAVITIES OF : .728 .729 (.730) (.731) .732

MOL PER CENT NITROGEN CONTENT	MOL PER CENT CARBON DIOXIDE CONTENT									
	2.0		2.2		2.4		2.6		2.8	
	F(P)	F(T)	F(P)	F(T)	F(P)	F(T)	F(P)	F(T)	F(P)	F(T)
0.0	0.9929	0.8995	0.9916	0.9002	0.9904	0.9010	0.9891	0.9016	0.9879	0.9024
0.2	0.9934	0.9007	0.9921	0.9014	0.9909	0.9022	0.9896	0.9029	0.9884	0.9036
0.4	0.9939	0.9020	0.9926	0.9026	0.9914	0.9034	0.9901	0.9041	0.9888	0.9049
0.6	0.9944	0.9032	0.9931	0.9039	0.9918	0.9046	0.9906	0.9053	0.9893	0.9061
0.8	0.9949	0.9043	0.9936	0.9050	0.9923	0.9058	0.9911	0.9065	0.9898	0.9072
1.0	0.9954	0.9056	0.9941	0.9062	0.9928	0.9070	0.9916	0.9077	0.9903	0.9085
1.2	0.9959	0.9068	0.9946	0.9075	0.9933	0.9082	0.9921	0.9089	0.9908	0.9097
1.4	0.9964	0.9080	0.9951	0.9087	0.9938	0.9095	0.9926	0.9102	0.9913	0.9110
1.6	0.9968	0.9092	0.9956	0.9100	0.9943	0.9107	0.9930	0.9114	0.9918	0.9122
1.8	0.9974	0.9105	0.9961	0.9112	0.9948	0.9120	0.9936	0.9127	0.9923	0.9134
2.0	0.9978	0.9117	0.9966	0.9124	0.9953	0.9131	0.9940	0.9138	0.9928	0.9146
2.2	0.9984	0.9129	0.9971	0.9136	0.9958	0.9144	0.9945	0.9151	0.9933	0.9159
2.4	0.9988	0.9142	0.9976	0.9149	0.9963	0.9156	0.9950	0.9164	0.9938	0.9171
2.6	0.9994	0.9154	0.9981	0.9161	0.9968	0.9169	0.9955	0.9176	0.9943	0.9184
2.8	0.9998	0.9167	0.9986	0.9174	0.9973	0.9182	0.9960	0.9189	0.9948	0.9197
3.0	1.0003	0.9179	0.9991	0.9186	0.9978	0.9194	0.9965	0.9201	0.9952	0.9209
3.2	1.0008	0.9192	0.9996	0.9199	0.9983	0.9207	0.9970	0.9214	0.9958	0.9222
3.4	1.0013	0.9205	1.0001	0.9212	0.9988	0.9220	0.9975	0.9227	0.9962	0.9235
3.6	1.0018	0.9216	1.0006	0.9224	0.9993	0.9232	0.9980	0.9239	0.9967	0.9247
3.8	1.0024	0.9229	1.0011	0.9236	0.9998	0.9244	0.9985	0.9252	0.9972	0.9260
4.0	1.0028	0.9242	1.0016	0.9249	1.0003	0.9257	0.9990	0.9264	0.9977	0.9272
4.2	1.0034	0.9255	1.0021	0.9262	1.0008	0.9270	0.9995	0.9277	0.9982	0.9285
4.4	1.0039	0.9268	1.0026	0.9275	1.0013	0.9283	1.0000	0.9290	0.9987	0.9298
4.6	1.0044	0.9281	1.0031	0.9288	1.0018	0.9296	1.0005	0.9303	0.9992	0.9311
4.8	1.0049	0.9293	1.0036	0.9300	1.0023	0.9308	1.0010	0.9315	0.9997	0.9324
5.0	1.0054	0.9306	1.0041	0.9313	1.0028	0.9321	1.0015	0.9328	1.0002	0.9336
5.2	1.0059	0.9319	1.0046	0.9326	1.0033	0.9334	1.0020	0.9341	1.0007	0.9350
5.4	1.0064	0.9332	1.0051	0.9339	1.0038	0.9347	1.0025	0.9354	1.0012	0.9363
5.6	1.0069	0.9345	1.0056	0.9352	1.0043	0.9360	1.0030	0.9368	1.0017	0.9376
5.8	1.0074	0.9358	1.0061	0.9365	1.0048	0.9373	1.0035	0.9381	1.0022	0.9389
(6.0)	1.0079	0.9371	1.0066	0.9378	1.0053	0.9387	(1.0040)	(0.9394)	1.0027	0.9402
6.2	1.0084	0.9384	1.0071	0.9392	1.0058	0.9400	1.0045	0.9407	1.0032	0.9416
6.4	1.0089	0.9396	1.0076	0.9404	1.0063	0.9412	1.0050	0.9420	1.0037	0.9428
6.6	1.0094	0.9410	1.0081	0.9417	1.0068	0.9426	1.0055	0.9433	1.0042	0.9441
6.8	1.0100	0.9423	1.0086	0.9430	1.0073	0.9439	1.0060	0.9446	1.0048	0.9455
7.0	1.0104	0.9436	1.0092	0.9444	1.0078	0.9452	1.0066	0.9460	1.0053	0.9468
7.2	1.0110	0.9450	1.0097	0.9457	1.0084	0.9466	1.0071	0.9473	1.0058	0.9482
7.4	1.0115	0.9463	1.0102	0.9471	1.0089	0.9479	1.0076	0.9487	1.0063	0.9495
7.6	1.0120	0.9476	1.0107	0.9484	1.0094	0.9492	1.0081	0.9500	1.0068	0.9509
7.8	1.0125	0.9489	1.0112	0.9497	1.0099	0.9505	1.0086	0.9513	1.0073	0.9521
8.0	1.0130	0.9503	1.0117	0.9510	1.0104	0.9519	1.0091	0.9526	1.0078	0.9535
8.2	1.0135	0.9516	1.0122	0.9524	1.0109	0.9532	1.0096	0.9540	1.0083	0.9549
8.4	1.0140	0.9530	1.0127	0.9538	1.0114	0.9546	1.0101	0.9554	1.0088	0.9562
8.6	1.0146	0.9543	1.0132	0.9551	1.0119	0.9560	1.0106	0.9567	1.0093	0.9576
8.8	1.0151	0.9557	1.0138	0.9565	1.0124	0.9573	1.0111	0.9581	1.0098	0.9590
9.0	1.0156	0.9571	1.0143	0.9578	1.0130	0.9587	1.0116	0.9595	1.0103	0.9604
9.2	1.0161	0.9584	1.0148	0.9591	1.0135	0.9600	1.0122	0.9608	1.0108	0.9616
9.4	1.0166	0.9598	1.0153	0.9605	1.0140	0.9614	1.0127	0.9622	1.0114	0.9630
9.6	1.0171	0.9611	1.0158	0.9619	1.0145	0.9628	1.0132	0.9636	1.0119	0.9644
9.8	1.0177	0.9625	1.0163	0.9633	1.0150	0.9642	1.0137	0.9650	1.0124	0.9658
10.0	1.0182	0.9639	1.0168	0.9647	1.0155	0.9656	1.0142	0.9664	1.0129	0.9672
10.2	1.0187	0.9653	1.0174	0.9661	1.0160	0.9670	1.0147	0.9678	1.0134	0.9686
10.4	1.0192	0.9667	1.0179	0.9675	1.0166	0.9684	1.0152	0.9692	1.0139	0.9700
10.6	1.0197	0.9680	1.0184	0.9688	1.0171	0.9697	1.0158	0.9705	1.0144	0.9714
10.8	1.0203	0.9694	1.0189	0.9702	1.0176	0.9711	1.0163	0.9719	1.0150	0.9728
11.0	1.0208	0.9708	1.0194	0.9716	1.0181	0.9725	1.0168	0.9733	1.0155	0.9742
11.2	1.0213	0.9722	1.0200	0.9730	1.0186	0.9739	1.0173	0.9747	1.0160	0.9756
11.4	1.0218	0.9737	1.0205	0.9745	1.0192	0.9754	1.0178	0.9762	1.0165	0.9770
11.6	1.0223	0.9751	1.0210	0.9759	1.0197	0.9768	1.0184	0.9776	1.0170	0.9785
11.8	1.0229	0.9765	1.0215	0.9773	1.0202	0.9782	1.0189	0.9790	1.0176	0.9799
12.0										

NOTE: EACH HEADING IS INCLUSIVE TO NEXT HIGHER HEADING. DO NOT INTERPOLATE.

VII-258 TABLE OF SUPERCOMPRESSIBILITY FACTORS, F_{pv}

To work Example 3

BASE DATA - 0.6 SPECIFIC GRAVITY HYDROCARBON GAS

METER GAUGE PRESSURE, PSIG	TEMPERATURE, DEGREES FAHRENHEIT									
	50	51	52	53	54	55	56	57	58	59
1000	1.0926	1.0918	1.0910	1.0902	1.0894	1.0886	1.0879	1.0871	1.0862	1.0855
1010	1.0936	1.0928	1.0920	1.0911	1.0903	1.0895	1.0888	1.0880	1.0872	1.0865
1020	1.0946	1.0938	1.0929	1.0920	1.0912	1.0904	1.0896	1.0888	1.0881	1.0873
1030	1.0955	1.0947	1.0938	1.0930	1.0922	1.0913	1.0905	1.0897	1.0890	1.0882
1040	1.0965	1.0956	1.0948	1.0939	1.0930	1.0922	1.0914	1.0906	1.0898	1.0890
1050	1.0974	1.0965	1.0957	1.0949	1.0940	1.0932	1.0924	1.0916	1.0908	1.0900
1060	1.0983	1.0974	1.0966	1.0957	1.0948	1.0940	1.0932	1.0924	1.0916	1.0908
1070	1.0992	1.0983	1.0975	1.0966	1.0957	1.0949	1.0940	1.0932	1.0924	1.0916
1080	1.1002	1.0993	1.0984	1.0975	1.0966	1.0958	1.0950	1.0940	1.0932	1.0924
1090	1.1011	1.1002	1.0993	1.0984	1.0975	1.0967	1.0959	1.0950	1.0941	1.0933
1100	1.1020	1.1011	1.1002	1.0993	1.0984	1.0976	1.0967	1.0958	1.0950	1.0941
1110	1.1029	1.1020	1.1011	1.1002	1.0993	1.0985	1.0976	1.0967	1.0959	1.0950
1120	1.1039	1.1029	1.1021	1.1010	1.1002	1.0993	1.0984	1.0976	1.0967	1.0958
1130	1.1048	1.1038	1.1030	1.1020	1.1012	1.1002	1.0993	1.0985	1.0975	1.0966
1140	1.1056	1.1047	1.1038	1.1029	1.1020	1.1010	1.1002	1.0992	1.0984	1.0974
1150	1.1065	1.1056	1.1047	1.1038	1.1029	1.1019	1.1011	1.1001	1.0993	1.0983
1160	1.1075	1.1066	1.1057	1.1046	1.1037	1.1028	1.1018	1.1010	1.1000	1.0992
1170	1.1084	1.1075	1.1066	1.1056	1.1047	1.1037	1.1027	1.1019	1.1009	1.1001
1180	1.1094	1.1085	1.1074	1.1064	1.1055	1.1045	1.1036	1.1027	1.1018	1.1009
1190	1.1103	1.1094	1.1084	1.1073	1.1064	1.1054	1.1044	1.1035	1.1026	1.1017
1200	1.1112	1.1102	1.1092	1.1082	1.1072	1.1062	1.1053	1.1044	1.1034	1.1025
1210	1.1121	1.1111	1.1101	1.1091	1.1081	1.1071	1.1061	1.1052	1.1042	1.1033
1220	1.1130	1.1120	1.1110	1.1099	1.1089	1.1079	1.1070	1.1060	1.1050	1.1041
1230	1.1139	1.1129	1.1119	1.1108	1.1098	1.1088	1.1078	1.1068	1.1058	1.1049
1240	1.1148	1.1137	1.1127	1.1117	1.1106	1.1096	1.1086	1.1076	1.1067	1.1057
1250	1.1157	1.1146	1.1136	1.1126	1.1115	1.1105	1.1094	1.1084	1.1075	1.1065
1260	1.1166	1.1155	1.1144	1.1134	1.1123	1.1113	1.1103	1.1093	1.1083	1.1073
1270	1.1175	1.1163	1.1152	1.1142	1.1131	1.1121	1.1111	1.1101	1.1090	1.1080
1280	1.1183	1.1172	1.1161	1.1150	1.1139	1.1129	1.1119	1.1108	1.1098	1.1088
1290	1.1192	1.1181	1.1170	1.1159	1.1148	1.1138	1.1127	1.1116	1.1106	1.1095
1300	1.1200	1.1190	1.1178	1.1168	1.1156	1.1146	1.1135	1.1124	1.1114	1.1103
1310	1.1209	1.1198	1.1186	1.1176	1.1164	1.1154	1.1143	1.1132	1.1122	1.1111
1320	1.1217	1.1206	1.1195	1.1184	1.1173	1.1162	1.1151	1.1140	1.1130	1.1119
1330	1.1226	1.1215	1.1204	1.1193	1.1182	1.1171	1.1159	1.1148	1.1138	1.1126
(1340)	1.1235	1.1224	1.1212	1.1201	1.1190	1.1178	1.1168	1.1156	1.1146	1.1134
1350	1.1243	1.1232	1.1220	1.1208	1.1197	1.1185	1.1175	1.1163	1.1153	1.1141
1360	1.1251	1.1240	1.1228	1.1216	1.1205	1.1194	1.1182	1.1172	1.1160	1.1150
1370	1.1260	1.1248	1.1236	1.1224	1.1213	1.1202	1.1190	1.1179	1.1167	1.1157
1380	1.1268	1.1256	1.1244	1.1233	1.1221	1.1209	1.1198	1.1186	1.1175	1.1164
1390	1.1277	1.1264	1.1252	1.1241	1.1228	1.1216	1.1205	1.1193	1.1182	1.1170
1400	1.1285	1.1273	1.1260	1.1248	1.1236	1.1224	1.1213	1.1201	1.1189	1.1178
1410	1.1293	1.1281	1.1268	1.1255	1.1243	1.1231	1.1220	1.1208	1.1196	1.1185
1420	1.1301	1.1288	1.1276	1.1264	1.1251	1.1239	1.1228	1.1216	1.1204	1.1193
1430	1.1308	1.1295	1.1283	1.1271	1.1258	1.1246	1.1235	1.1223	1.1211	1.1199
1440	1.1316	1.1303	1.1291	1.1279	1.1266	1.1253	1.1241	1.1229	1.1218	1.1206
1450	1.1323	1.1310	1.1298	1.1286	1.1272	1.1260	1.1248	1.1236	1.1225	1.1213
1460	1.1331	1.1316	1.1306	1.1293	1.1280	1.1268	1.1256	1.1244	1.1232	1.1220
1470	1.1339	1.1326	1.1314	1.1300	1.1287	1.1275	1.1263	1.1251	1.1239	1.1227
1480	1.1347	1.1334	1.1321	1.1308	1.1295	1.1282	1.1270	1.1258	1.1246	1.1234
1490	1.1354	1.1341	1.1328	1.1315	1.1301	1.1289	1.1277	1.1265	1.1253	1.1241
1500										

NOTE: EACH HEADING IS INCLUSIVE TO NEXT HIGHER HEADING. DO NOT INTERPOLATE.

Standing beside Oklahoma Natural's highway sign is W. J. Montgomery, vice president of Beals Advertising, conductor of the survey of highway traffic promotions.

Utilities and LPG dealers team up to promote gas

IN a unique display of utility-LPG dealer teamwork, nearly all of Oklahoma's gas distributing companies and a major share of the leading LPG outlets have joined up in a tremendous campaign to plaster the state with highway signs extolling the advantages of gas.

This campaign was made possible by widespread conviction among both utilities and dealers that, after all, gas is gas—be it natural, manufactured, or liquefied. As Hal North, Oklahoma Natural Gas Corp. (Tulsa) advertising and sales promotion director, puts it, "The individual's reaction to the word 'gas' is naturally interpreted in terms of his own experience.

"If the sign reader is a natural gas consumer," declares Mr. North, "he will interpret the word 'gas' in terms of his own experience with the type of gas he is using. On the other hand, if the sign reader is accustomed to LPG service . . . or lives where LPG, not natural, is available, he will think of the word in terms of that fuel."

"I don't believe it matters whose name is on the sign," says Carl Williams, president of Williams Butane Co., Sulphur. "I get a real bang out of going down the road and seeing all those beautiful signs that sell 'gas.' That's the important thing to me."

The impact of the billboard campaign promises to be overwhelming. According to late reports, more than 150 signs had been spoken for, with the total expected to rise to 200 in short order. Measuring 7 ft high by 12 ft wide, the signs shout, "Let us prove, for cooking, gas is best." At the bottom is a generous space for dealer imprint. A large flame decorates the boards. The flame and all lettering is in Scotchlite. Combining four fluorescent colors, the signs are easily read day and night.

The dealer (or the utility) owns its own sign. Each sign is installed in a selected location for the three-year duration of the campaign. Copy may be prepared individually to promote any gas use desired. With a setup such as this, it has been unnecessary to establish a central fund. Each dealer or utility pays for its own unit.

When the cooperative scheme was presented without advance publicity back in April, members of the Oklahoma L. P. Gas Association in their spring convention were quick to recognize its merits as a promising means of bringing about unified action in the industry. Lewis Mitchell, association president, remarked at that time on the dangers inherent in a "do-little" or "do-nothing" attitude and stated that in his opinion, LPG dealers must *sell* the benefits and advantages of gas consistently to protect their future.

Mr. Mitchell, Standard Gas & Equipment Co., Clinton, Okla., was the first LPG dealer in the Oklahoma group to

Meeting to review the highway sign program's rapid progress were (l to r, standing) Lewis Mitchell, Glenn Springer, John Deupree, Hal North. (Seated): Carl Williams, Mrs. Springer, and Earl Newlin.

Highway signs... What if these signs were seen from coast to coast?

The message is the same but the signature is different. Here, Standard Gas & Equipment, a butane dealer, joins in the highway sign program.

buy the signs for his company, and took the lead in encouraging statewide acceptance of the program.

Sign locations confirmed as of this writing include the following utilities: Burlingame Corp., Bartlesville; Northern Oklahoma Gas, Ponca City; Oklahoma Natural Gas, Tulsa; Southwest Natural Gas, Ada; State Fuel Supply, Oklahoma City; Tri-Cities Gas, Hartshorne; and the Zenith Gas System, Alva.

Locations have been confirmed for L.P. gas dealers as follows: Associated Gas Co., Lindsay; Butane Sales Inc., Lawton; Standard Gas & Equipment Co., Clinton; Truitt Butane Co., Carnegie; Williams Butane Co., Sulphur; Dewey Wood Butane Co., Ardmore; and Younkin Propane Co., Anadarko.

At a meeting July 22 of LPG and natural gas utility representatives who are participating in the state-wide program, Mr. Mitchell said: "If we fail to impress the consumer with the superiority of gas and allow the electrical trend to continue unchecked, then one of these days we are apt to find that all the time, effort and investment we have in our various businesses will be worthless!"

Then, in high good humor, Mr. Mitchell commented that his wife had seen so many electric signs lately that he actually had had to give his wife a "selling talk" on the advantages of gas. "Even she was beginning to believe the electric story," Mitchell said. "After all, you do see electric signs just about everywhere you go!"

Other elements of the industry were brought into the discussion by Earl Newlin, president of State Fuel Supply Co., Oklahoma City. Mr. Newlin observed that "we all have a common ground to cover . . . we have the same problems, the same jobs, the same goals . . . and with this united effort, we can consistently do a real selling job. Furthermore," he added, "I have been thinking of our suppliers and others and I definitely feel that a great many of them will want to go along with us in this unified highway sign program."

Powerful potential seen

Glenn Springer, executive secretary of the Oklahoma L.P. Gas Association, expressed the pride of his association in setting a pattern that may be copied by other groups throughout the nation. "Think," he said, "what a powerful influence it would exert if these same boards could be seen from coast to coast!"

An interesting sidelight on Mr. Springer's statement is that the board of directors of the Pennsylvania LPGA have endorsed the sign program and organization plans are already under way.

Leading the Pennsylvania effort is the United Gas Improvement Co., Philadelphia. Gordon Jones, sales manager of UGI, approved his company's acceptance of the plan to provide a springboard for the joint effort. The sign format in the Pennsylvania program is identical to the Oklahoma design and will be fabricated and serviced by the same firm, which has national facilities.

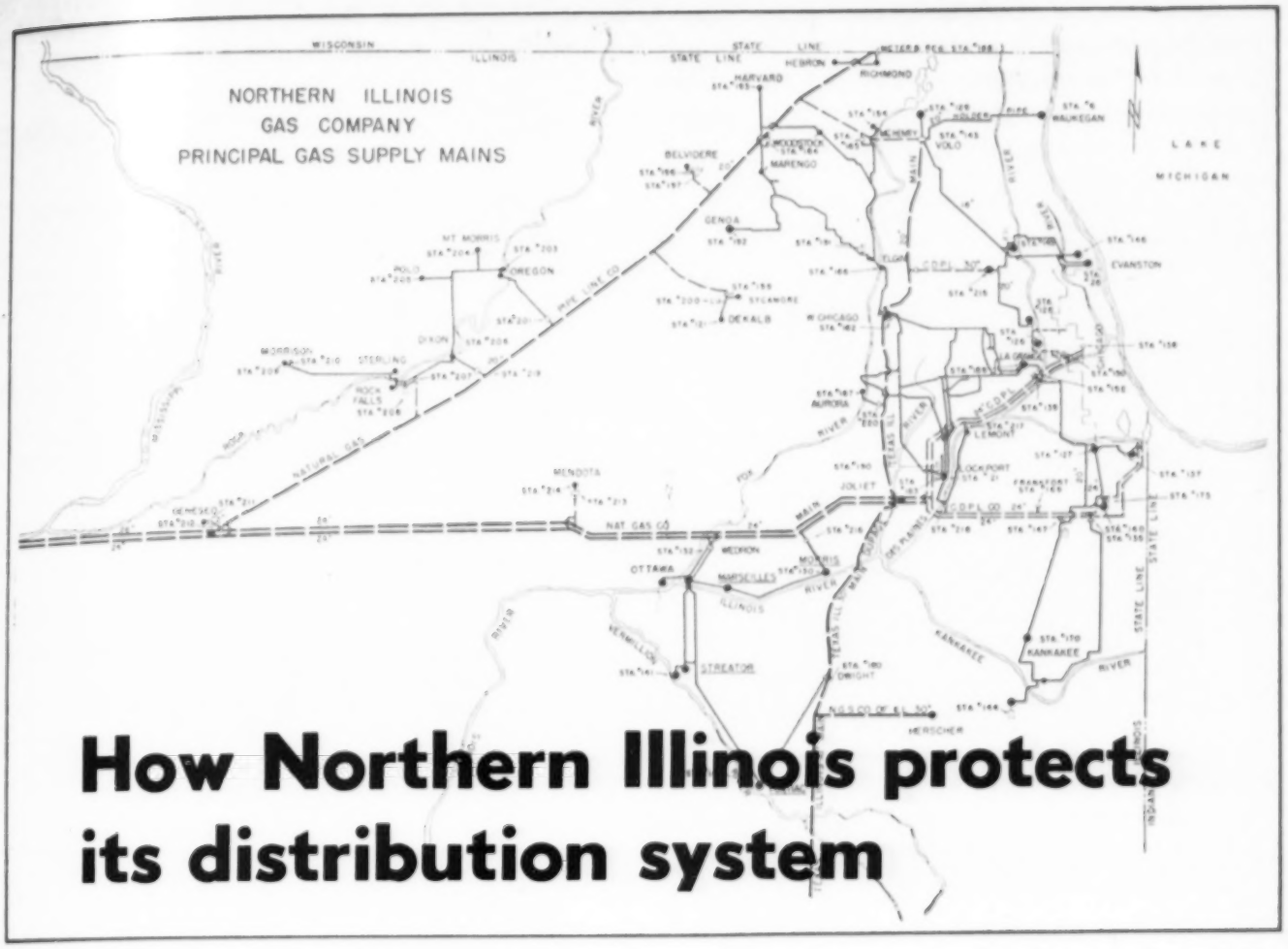
As further evidence of the growing trend, it is noted that the sign program is in agreement with the resolution offered by W. R. Sidenfaden, past president, at the LPGA convention in Chicago last May, calling for unified industry promotion.

Traffic study made

Before the highway sign program was initiated, under the auspices of the Beals Advertising Co., Oklahoma City, an exhaustive survey and analysis was made of highway traffic promotions to determine how best to serve the gas industry. It was realized that in many cases the cost of such a program would be prohibitive if undertaken by the individual utility or LPG dealer. Accordingly, it was planned in volume to serve a unified industry effort on a reasonably small unit cost basis.

A study of traffic factors showed that 81% of all cars entering or leaving a trading center carry people who live in that area. The study also showed that more than 90% of all residents of a trading center make one or more trips in and out of the center within a 30-day period. With the use of highway signs on the main approaches to town, and at strategic points along the highway, utilities and LPG dealers alike will achieve excellent coverage of their prospects for gas and gas appliances in and around their trading areas.

"Yes, the signs are as repetitious as Burma-Shave . . . but a darn sight more readable, and more attractive!" So say the determined and aggressive Oklahoma leaders who have teamed up to fight back in volume against Reddy Kilowatt!



How Northern Illinois protects its distribution system

By **M. G. MARKLE** • Northern Illinois Gas Co., Bellwood, Ill.

The cathodic protection procedure that is now in force at Northern Illinois Gas Co. began in 1947, but it had actually been under consideration and test for many years before that.

The company had long pursued an active program of corrosion control. Experimental work with coal tar and asphalt coatings was carried on long before there was general interest in coatings throughout the gas industry. Northern Illinois Gas participated in the research in the early 1920s with AGA and the Bureau of Mines, and as a result of these studies the use of coatings to protect steel pipe construction was used as early as 1925.

By 1930, practically all new underground steel pipe installations were protectively coated.

Today, more than half of the steel distribution mains, about 16 million ft, and about 50% of the services are coated. In spite of this corrosion failure continued to appear on practically new facilities. By 1942 the company's coating policy was being questioned as to its economic value and some of the engineers even advocated the return to the use of extra heavy pipe instead of coating.

It was at this point that the engineering department's attention became focussed on the possibilities of using cathodic protection in conjunction with coatings. Field experimentation was soon begun.

The first installation of rectifiers was made in 1944 when an 8-in. coated and wrapped steel main supplying the city of Kankakee, Ill., had to be replaced. A pilot installation was made in 1944 on 3000 ft of 2-in. main with 66 service connections. A rectifier installation made at that time decreased the leak occurrence and is, in fact, still operating satisfactorily. Other installations were made from time to time until in 1945 the decision was made to go into cathodic protection on a large scale.

SUCCESSFUL conclusion of several years of trial installations of cathodic protection in the system of Northern Illinois Gas Co. convinced the engineers, operating men, and management that such protection should be applied to the distribution system if it were economically feasible to do so.

A corrosion engineer was appointed in 1945 to study the problem and formulate a program to be followed. His study indicated that four distinctly different programs should be considered:

1. Application of cathodic protection with a good coating procedure on all new installations of pipe underground.
2. Protection of all of our existing sup-

The map above is of the service area of Northern Illinois. The company serves approximately 480,000 customers located in 236 communities and 17 counties. The system includes approximately 33 million ft of main of various sizes of which 80% is steel and the rest is cast iron. About 30 million ft of steel service pipe is included.

SUPERSEDES G.C.S. 213.1 5-18-51

G.C.S. 213.01 TO G.C.S. 213.02

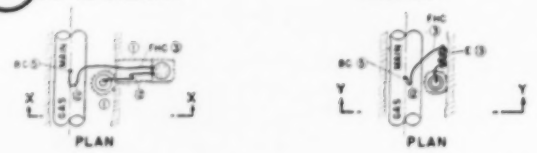
4-6-54

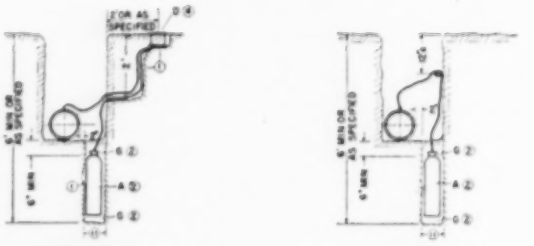
ANODE INSTALLATIONS

1 SINGLE ANODE IN TRENCH FOR NEW MAIN

G.C.S. 213.01 WITH TEST CONNECTION

G.C.S. 213.02 ANODE ONLY





NOTES

① TO ⑤ REFER TO INSTRUCTION OF SAME NUMBER, G.C.S. 213

⑪ BORE HOLE WITH AUGER, 8" MIN DIA FOR READY-PACKED ANODE, 6" MIN DIA FOR BARE ANODE

⑫ LEAVE APPROXIMATELY 6" SLACK IN WIRE

⑬ WIND 2 OR 3 TURNS OF WIRE AROUND LATH OR BOARD TO AID IN PLACING AND LOCATING LOOP

SYMBOLS ——— GROUND LINE ——— LINE OF EXCAVATION

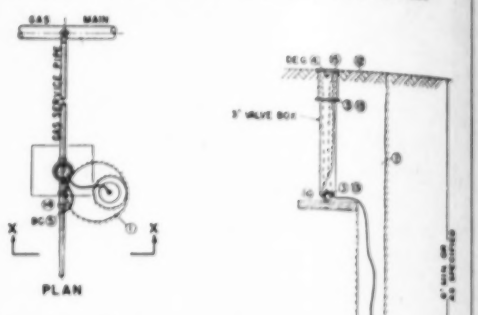
LOC	MATERIALS REQUIRED	QUANTITY 213.01	QUANTITY 213.02	GMS NO
A	MAGNESIUM ANODE, WT 17# UNLESS SPECIFIED OTHERWISE, BARE OR READY-PACKED, WITH #12 T W INSULATED WIRE LEAD	1	1	
B	#15 THERMITE WELD CARTRIDGE AND COPPER SLEEVE OR EQUIVALENT	1	1	
C	PIPE COATING TAPE OR COLD-APPLIED BITUMINOUS COATING	AS REQ		
D	5" FRAME AND COVER ASSEMBLY	1	0	632
E	LATH OR BOARD	0	1	
F	#12 T W INSULATED WIRE	AS REQ		
G	READY MIX BACKFILL, FOR EACH BARE ANODE	30#	30#	
H	INSULATING TAPE AND FRICTION TAPE	AS REQ		

G.C.S. 213.07

4-19-54

ANODE INSTALLATION

2 ON SERVICE PIPE TO PROTECT STEEL MAINS AND SERVICES



NOTES

① TO ⑤ REFER TO INSTRUCTION OF SAME NUMBER, G.C.S. 213

⑪ BORE HOLE WITH AUGER, 8" MIN DIA FOR READY-PACKED ANODE, 6" MIN DIA FOR BARE ANODE

⑫ BORE 12" DIA HOLE WITH AUGER, THEN ENLARGE TO EXPOSE SERVICE PIPE

⑮ RUN WIRE LEADS THROUGH BOTTOM OF VALVE BOX, OR ½" DIA HOLE IN SIDE, APPROXIMATELY 9" BELOW COVER

⑯ IF SERVICE INCLUDES COMPRESSION SLEEVES OR COUPLINGS, AND TESTS INDICATE IT NECESSARY, INSTALL BOND WIRE (G.C.S. 261) AND PIPE COATING (866.01) ON EACH

⑰ MOVE VALVE BOX AS REQUIRED TO BRING ELEVATION OF COVER TO GROUND SURFACE

⑱ BLOCK WAS OMITTED FROM OLDER SERVICE INSTALLATIONS.

SYMBOLS ——— GROUND LINE ——— LINE OF EXCAVATION

LOC	MATERIALS REQUIRED	QUANTITY	GMS NO
A	MAGNESIUM ANODE, WT 17# UNLESS SPECIFIED OTHERWISE, BARE OR READY-PACKED WITH #12 T W INSULATED WIRE LEAD	1	
B	#15 THERMITE WELD CARTRIDGE & COPPER SLEEVE OR EQUIVALENT	1	
C	PIPE COATING TAPE OR COLD-APPLIED BITUMINOUS COATING	AS REQ	
D	ELECTRICAL SPRING CONNECTOR FOR 2 #12 WIRES, SCOTCHLOK TYPE M, OR EQUIV.	AS REQ	
E	#12 T W INSULATED WIRE	AS REQ	
G	READY MIX BACKFILL, FOR EACH BARE ANODE	30#	
H	INSULATING TAPE AND FRICTION TAPE	AS REQ	

SUPERSEDES G.C.S. 213.3, 213.4 5-18-51

G.C.S. 213.03 TO G.C.S. 213.04

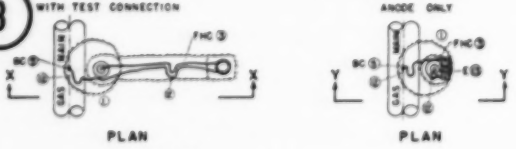
4-6-54

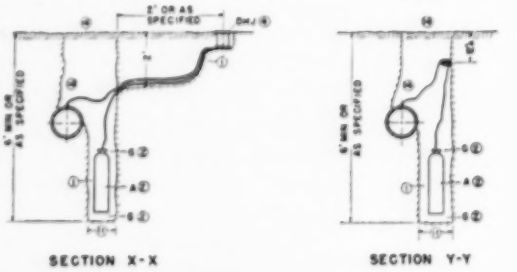
ANODE INSTALLATIONS

3 SINGLE ANODE AND CONNECTION TO MAIN IN SAME EXCAVATION

G.C.S. 213.03 WITH TEST CONNECTION

G.C.S. 213.04 ANODE ONLY





① TO ⑤ REFER TO INSTRUCTION OF SAME NUMBER, G.C.S. 213

⑪ BORE HOLE WITH AUGER, 8" MIN DIA FOR READY-PACKED ANODE, 6" MIN DIA FOR BARE ANODE

⑫ LEAVE APPROXIMATELY 6" SLACK IN WIRE

⑬ WIND 2 OR 3 TURNS OF WIRE AROUND LATH OR BOARD TO AID IN PLACING AND LOCATING LOOP

⑭ BORE 12" DIA HOLE WITH AUGER, THEN ENLARGE TO EXPOSE MAIN

SYMBOLS ——— GROUND LINE ——— LINE OF EXCAVATION

LOC	MATERIALS REQUIRED	QUANTITY 213.03	QUANTITY 213.04	GMS NO
A	MAGNESIUM ANODE, WT 17# UNLESS SPECIFIED OTHERWISE, BARE OR READY-PACKED, WITH #12 T W INSULATED WIRE LEAD	1	1	
B	#15 THERMITE WELD CARTRIDGE AND COPPER SLEEVE OR EQUIVALENT	1	1	
C	PIPE COATING TAPE OR COLD-APPLIED BITUMINOUS COATING	AS REQ		
D	5" FRAME AND COVER ASSEMBLY	1	0	632
E	LATH OR BOARD	0	1	
F	#12 T W INSULATED WIRE	AS REQ		
G	READY MIX BACKFILL, FOR EACH BARE ANODE	30#	30#	
H	INSULATING TAPE AND FRICTION TAPE	AS REQ		
J	ELECTRICAL SPRING CONNECTOR FOR 2 #12 WIRES, SCOTCHLOK TYPE M, OR EQUIV.	1	0	

SUPERSEDES G.C.S. 213.2 5-18-51

G.C.S. 213.05 TO G.C.S. 213.06

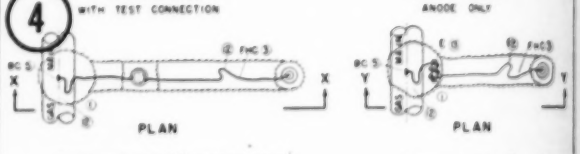
4-6-54

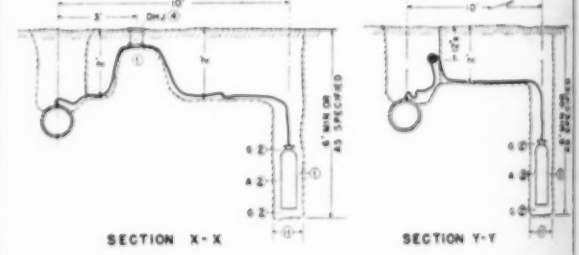
ANODE INSTALLATIONS

4 SINGLE ANODE AND CONNECTION TO MAIN IN SEPARATE EXCAVATIONS

G.C.S. 213.05 WITH TEST CONNECTION

G.C.S. 213.06 ANODE ONLY





NOTES

① TO ⑤ REFER TO INSTRUCTION OF SAME NUMBER, G.C.S. 213

⑪ BORE HOLE WITH AUGER, 8" MIN DIA FOR READY-PACKED ANODE, 6" MIN DIA FOR BARE ANODE

⑫ LEAVE APPROXIMATELY 6" SLACK IN WIRE

⑬ WIND 2 OR 3 TURNS OF WIRE AROUND LATH OR BOARD TO AID IN PLACING AND LOCATING LOOP

SYMBOLS ——— GROUND LINE ——— LINE OF EXCAVATION

LOC	MATERIALS REQUIRED	QUANTITY 213.05	QUANTITY 213.06	GMS NO
A	MAGNESIUM ANODE, WT 17# UNLESS SPECIFIED OTHERWISE, BARE OR READY-PACKED, WITH #12 T W INSULATED WIRE LEAD	1	1	
B	#15 THERMITE WELD CARTRIDGE AND COPPER SLEEVE OR EQUIVALENT	1	1	
C	PIPE COATING TAPE OR COLD-APPLIED BITUMINOUS COATING	AS REQ		
D	5" FRAME AND COVER ASSEMBLY	1	0	632
E	LATH OR BOARD	0	1	
F	#12 T W INSULATED WIRE	AS REQ		
G	READY MIX BACKFILL, FOR EACH BARE ANODE	30#	30#	
H	INSULATING TAPE AND FRICTION TAPE	AS REQ		
J	ELECTRICAL SPRING CONNECTOR FOR 2 #12 WIRES, SCOTCHLOK TYPE M, OR EQUIV.		0	

SUPERSEDES G.C.S. 340.01 TO 340.01 D-9-52

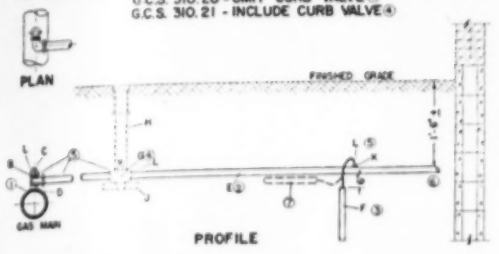
G.C.S. 310.20 TO G.C.S. 310.21

9-10-54

SERVICE INSTALLATION
LOW PRESSURE SYSTEM

1¼-INCH OUTER PORTION, FROM CAST IRON MAIN TO OUTSIDE OF BUILDING

G.C.S. 310.20 - OMIT CURB VALVE ④
G.C.S. 310.21 - INCLUDE CURB VALVE ④



NOTES:
① DRILL AND TAP MAIN, 1¼" NPT
② GRADE PIPE UNIFORMLY TO MAIN
③ DRIVE ANODE INTO EARTH UNTIL TOP IS 6" BELOW SERVICE PIPE. IF ROCK IS ENCOUNTERED, LAY ANODE IN SIDE OF DITCH ON SHORT SIDE SERVICES ATTACH MIDWAY BETWEEN MAIN AND BUILDING ON LONG SIDE SERVICES ATTACH AT CURB NEAREST TO BUILDING
④ BRAZE WIRE, PREFERABLY WITH THERMITE PROCESS, TO CLEAN PIPE SURFACE. TEST BRAZED CONNECTION BY TAPPING WITH HAMMER.
⑤ INSTALL CURB VALVE, BOX AND BLOCK WHEN REQUIRED BY G.C.S. 300.
⑥ COVER FITTINGS, CURB VALVE, AND AREAS OF DAMAGE TO PIPE COATING WITH COATING TAPE (G.C.S. 868.11)
⑦ FOR DETAILS FROM THIS POINT TO INSIDE OF BUILDING SEE G.C.S. 310.30 TO G.C.S. 310.39
⑧ ALTERNATE POSITION OF ANODE (FOR ROCKY SOIL)

5

LOC	MATERIALS REQUIRED	QUANTITY 310.20	QUANTITY 310.21	G.M.S. NO
B	1¼" STREET TEE	1	1	304
C	1¼" SCREWED PLUG	1	1	
D	1¼"-90° INSULATING COMPRESSION STREET ELL	1	1	
E	1¼" C B & W STEEL PIPE	AS REQ		
F	1# BARE MAGNESIUM ANODE WITH #12 TW INSULATED WIRE LEAD	1	1	
G	1¼" CURB VALVE	0	1	
H	5" VALVE BOX	0	1	
J	WOOD BLOCK, 2"X10"X12"	0	1	
K	#15 THERMITE WELD CARTRIDGE & COPPER SLEEVE	1	1	
L	PIPE COATING TAPE	AS REQ		

SUPERSEDES G.C.S. 340.01 TO 340.12, PAGE 2 3-26-52

G.C.S. 310.30 TO G.C.S. 310.31

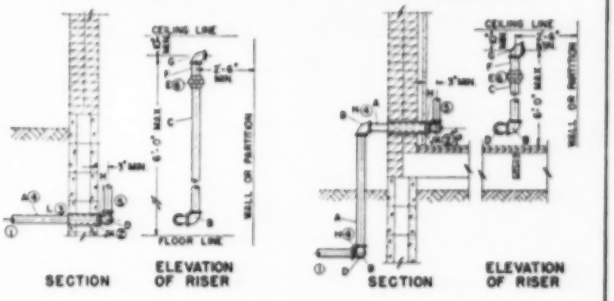
1-26-55

SERVICE INSTALLATION
LOW PRESSURE

1¼-INCH INNER PORTION, FROM OUTSIDE TO INSIDE OF BUILDING

G.C.S. 310.30
BUILDING WITH BASEMENT

G.C.S. 310.31
BUILDING WITHOUT BASEMENT



NOTES:
① FOR DETAILS FROM THIS POINT TO MAIN SEE G.C.S. 310.20 TO G.C.S. 310.29
② CUSTOMER TO PROVIDE GAS TIGHT CASING THROUGH WALL (G.C.S. 950.1 TO G.C.S. 950.3)
CAULK SERVICE PIPE INTO PLACE WITH YARN AND SEAL WITH 1:2 MIX PORTLAND CEMENT GROUT
IF CASING IS NOT PROVIDED AND THERE IS NO AIR SPACE WITHIN WALL, SERVICE MAY BE INSTALLED WITHOUT CASING
③ IF NECESSARY TO RESTORE WATERPROOFING, COVER WALL AREA SURROUNDING SERVICE ENTRANCE WITH ASPHALT ROOFING CEMENT OR EQUIVALENT
④ COVER FITTINGS AND AREAS OF DAMAGE TO PIPE COATING WITH COATING TAPE (G.C.S. 868.11)
⑤ INSTALL RISER AS CLOSE TO WALL AS PRACTICABLE
⑥ INSTALL WITH TAIL PIECE AND INSULATING GASKET DOWNWARD

6

LOC	MATERIALS REQUIRED	QUANTITY 310.30	QUANTITY 310.31	G.M.S. NO
A	1¼" C & W STEEL PIPE	AS REQ		
B	1¼"-90° SCREWED ELL	1	3	301
C	1¼" BARE STEEL PIPE	AS REQ		
D	1¼"-90° STREET ELL	1	2	302
E	1¼" SCREWED INSULATING UNION	1	1	315
F	1¼" X 4" NIPPLE	1	1	
G	1¼"-90° SCREWED ELL & PLUG, SIZE OF OUTLET TO ACCOMODATE METER INSTALLATION	1		309
H	PIPE COATING TAPE	AS REQ		
J	YARN, NOT TARRED	AS REQ		
K	PORTLAND CEMENT AND SAND	AS REQ		
L	ASPHALT ROOFING CEMENT	AS REQ	0	

ply mains by the use of rectifiers or anodes as dictated by an economic study.

3. Protection by cathodic application to as much of the existing distribution systems within town boundaries as possible with consideration being given to economic justification and the practicability of such an installation.

4. Study and analysis of the stray current areas to effectively control their drainage.

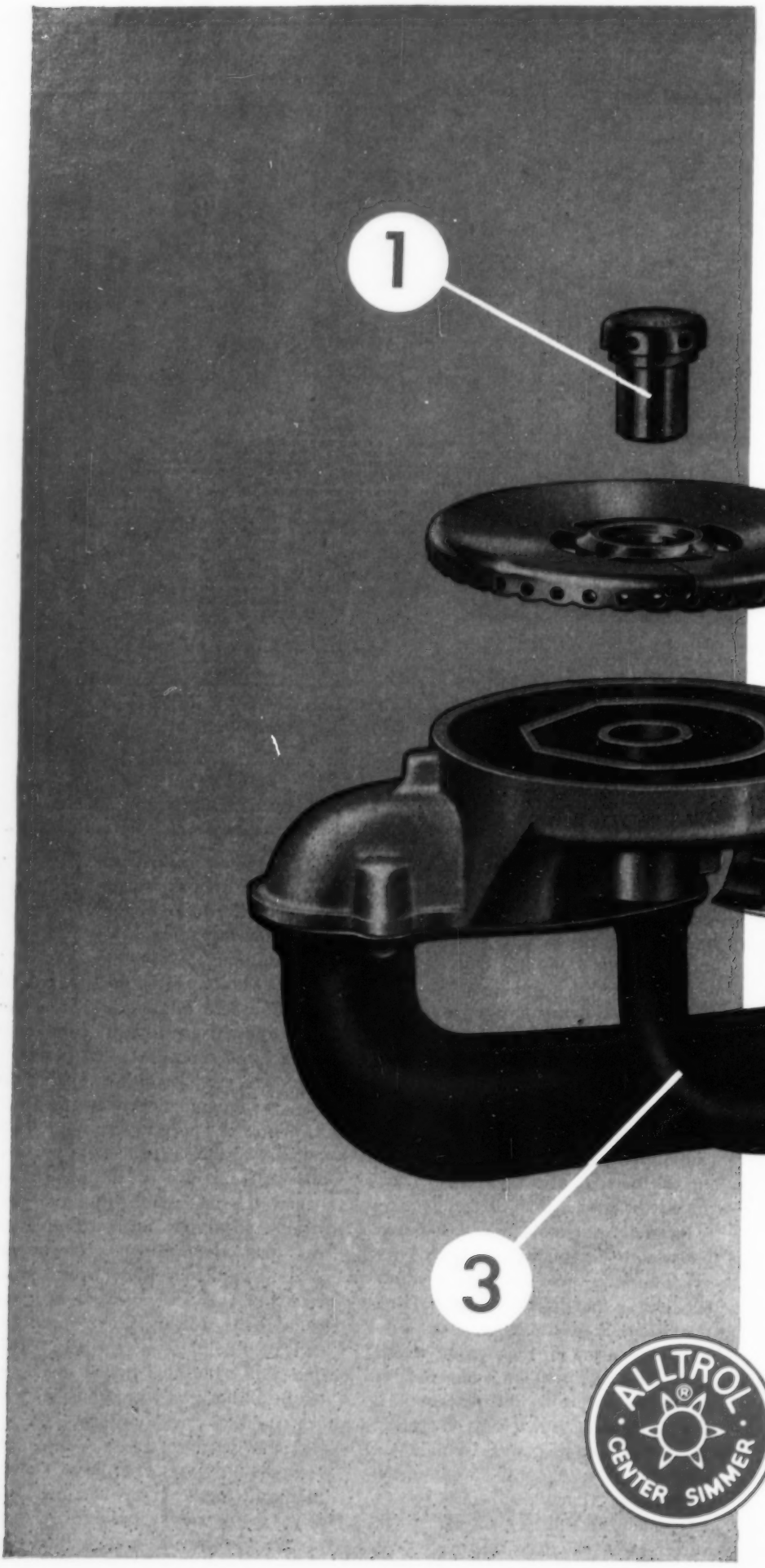
• Application of cathodic protection with a good coating procedure on all new installations of pipe underground.

For very good reasons it was decided to concentrate first on providing protection to all new installations. Studies made during the war period indicated that the company was about to enter an expansion program of considerable extent. There appeared to be good prospects of an additional supply of natural gas to the Chicago area, and plans were being formulated to make a complete conversion to natural gas. Also, there was every reason to believe that the building of homes in the company territory would increase greatly after the war, resulting in increased activities to extend gas facilities. And last, but not least, the economics of applying cathodic protection to new installations of distribution main appeared very favorable. By the use of magnesium anodes, cathodic protection could be applied to a new installation of steel main for not more than 1.0% of the total cost, making the complete protection job, including the coating, 6 to 8%—depending on the size. These percentages, by the way, still hold about the same today.

Progress in establishing a standard practice to be followed on new construction was slowed down considerably because of the difficulty in obtaining the materials needed to start the program. Procuring the magnesium anodes provided a real problem, and a suitable insulating feature for the meter set was not being made at that time. However, in less than two years (by the middle of 1947) the first step of the program was in full swing. Every new service off of a steel main included an insulating feature ahead of the meter and every order for a new steel main passed over the desk of the corrosion engineer for his designation of location and number of anodes and insulating flanges.

In addition, the corrosion engineer had carried on an intensive program of instruction and training with the line and working organizations of the company to gain support and cooperation. It was believed that the success or failure of the program depended greatly on the degree of appreciation by the line, and the working organization particularly, that corrosion control was fundamental to the performance of their duties. Accordingly, the corrosion engineer took advantage of every opportunity to explain to these organizations exactly what caused corrosion as it was found in the field, and how he expected, with their help, to prevent it in the future. This paid dividends, as evidenced by the enthusiasm with which they accepted the new responsibility.

In the years that have elapsed, the company has laid 8.6 million ft of cathodically protected pipe. Practically all of this work was done with magnesium anodes, rectifiers being used only on



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Distribution system protection... The greater number of installations was done by a contractor

rare occasions where convenience and economy dictated. The greater portion of these anode installations were made by a contractor. The work load involved with running new services and normal maintenance necessitated contracting the greater portion of new main construction, including the installation of cathodic protection facilities.

Contracting on a unit cost basis requires standards for construction, explicit in all details. *Figs. 1, 2, 3, 4, 5,* and *6* provide some examples. No explanation or comments concerning these standards are included because, to the best of my knowledge, they are quite consistent with general practice.

Coating specifications of the company call for all pipe to be mill coated with a minimum of 3/32 in. of plasticized coal tar reinforced with glass, and all joints and fittings wrapped with a coal tar tape. Visual inspection before the main is lowered into the ditch is all that is required. Frankly, our engineers are not happy with the disproportionate cost of the coating in the whole protection job, which is about 85% as indicated by figures quoted previously. It is their opinion that costs should be nearer 50% for coating and 50% for cathodic protection. If this proportion were attainable, the total cost for protection should be less. Coatings available today were designed and are still being sold to accomplish the whole protection job. What is needed in the industry is one that is suitable to use only in conjunction with cathodic protection. Possibly, when cathodic protection becomes more universally accepted as a necessary adjunct to coating for pipe protection, the demand for a coating tailored to fit the job will become great enough to result in the research necessary to find one that is suitable.

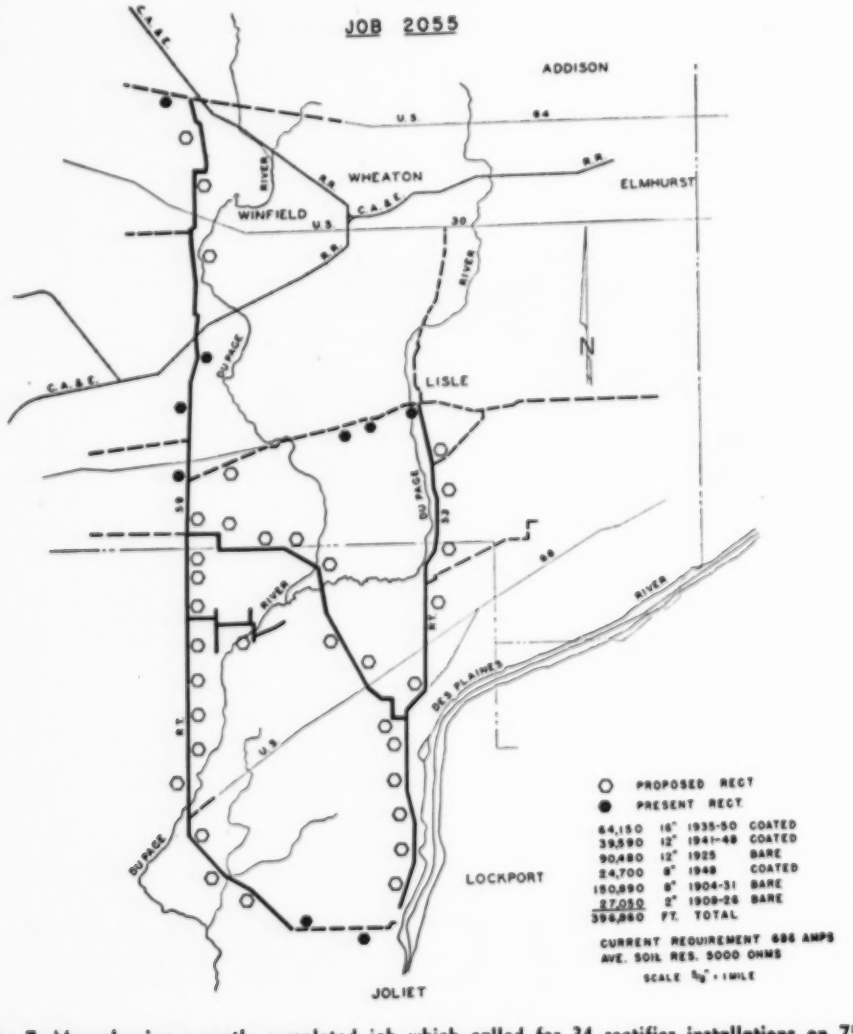

Fig. 7. Map showing recently completed job which called for 34 rectifier installations on 75 miles of interconnected supply mains.

Although Northern Illinois Gas coating and cathodic installations conform pretty well to general practice, they differ from many on the method of engineering pipe protection on new construction; they do not make field surveys of soil conditions before design. Everything that goes underground is coated, and cathodic facilities are specified by rule of thumb based on experience and knowledge of existing and/or expected conditions. After the job has been completed and has had time to become stabilized, a field check is made and the facilities then corrected if necessary. This combination of a standard coating and a minimum of field engineering in advance of construction lends itself very well to distribution work where the jobs are small and numerous and may be installed by a contractor or company crews. The evidence of this is that the engineering cost for pipe protection on new construction is less than one-half of 1%.

There are a number of low pressure systems of cast iron construction within the company. These are being expanded, principally for new business loads, with cast iron. Standard practice is to take a service off of cast iron with 1¼-in. steel pipe coated to our standard specification. The service is insulated from the house piping by an insulating union just ahead of the meter and from the main by an insulating street ell off of the street tee screwed into the main. A 1-lb magnesium anode is connected to the service between the insulating joints and buried with the pipe. All new and renewed low pressure services have been treated this way since 1949.

It is apparent that cathodic protection is not being applied to the street tee and the insulating street ell. This is an undesirable condition that out engineers have attempted to correct over the years, but have met with no success. The insulating joint should be between the street tee and the cast iron pipe. A plastic bushing appeared to be the best solution; yet tests of various plastics in the form of a bushing revealed none that could be considered satisfactory because either the cold flow characteristics were such as to eventually produce a leak, or failures could be expected under strain because of brittleness, or the materials were not suitable for underground service. At present, the research

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. . . Distribution system protection

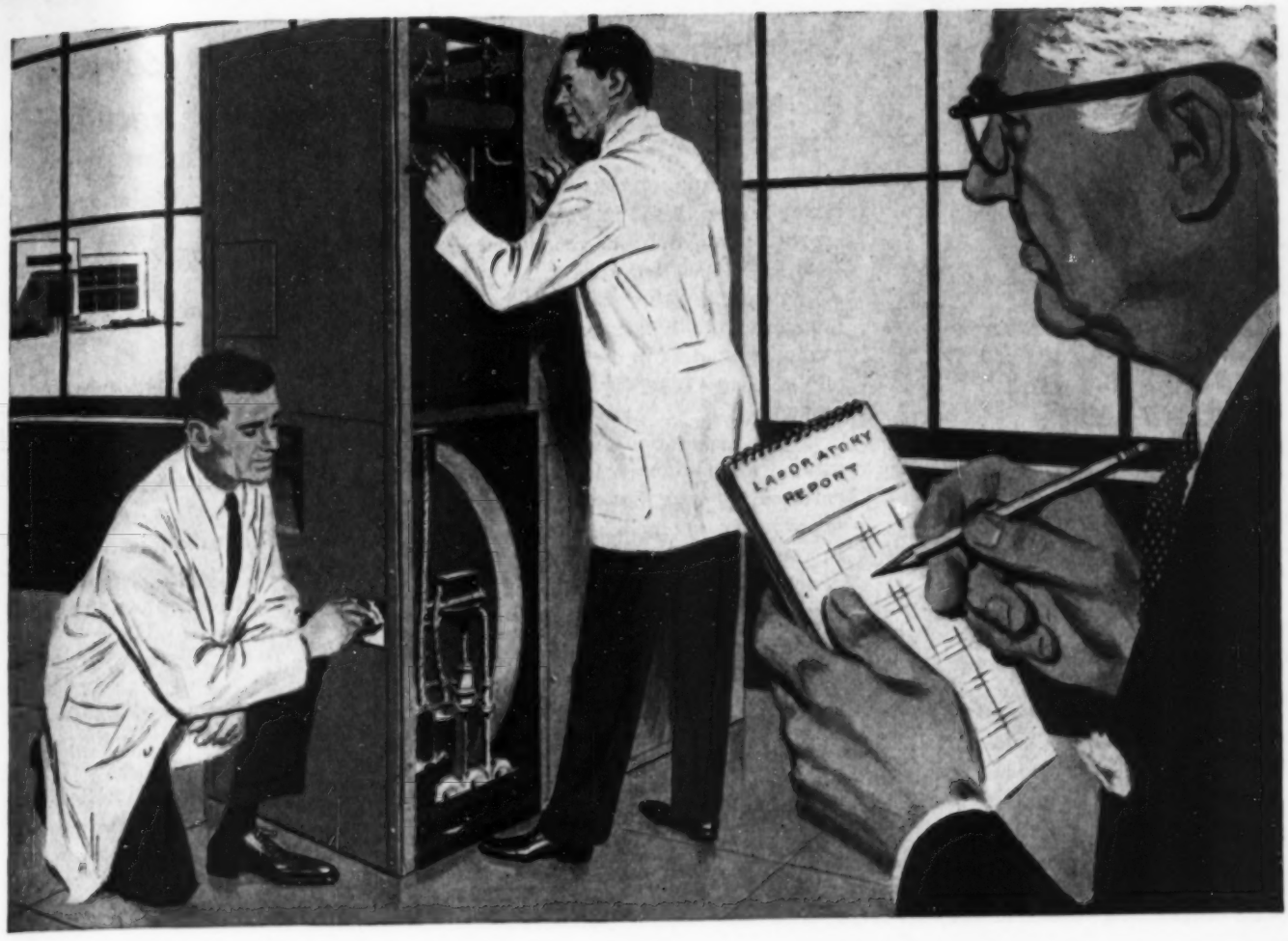
is at a dead end, but it is the general opinion that the plastic industry will come up with a suitable product.

• Protection of all of our existing supply mains by the use of rectifiers or anodes as dictated by an economic study.

With cathodic protection being applied to new construction in a routine manner, considerable engineering time and manpower was made available to pursue the second step of the program —the protection of all of the supply mains in service before 1947. A total of 701 miles of pipe ranging in size from 3 in. to 16 in. was involved, some of it coated satisfactorily, some with materials of dubious quality, and much of it bare. Obsolescence because of size had to be considered, a factor that was difficult to resolve because of the rapid expansion of the system. Any supply main that was deemed renewable for size in the near future was placed at the bottom of the list; those considered suitable in size, regardless of age or condition, were reviewed for a possible cathodic application.

To date 360 miles of the original supply mains have been protected. The last job, just completed through last winter, called for 34 rectifier installations on 75 miles of interconnected supply mains (see *Fig. 7*). The tabulation included with *Fig. 7* shows the size, age, and type of coating on all the mains involved in this project. A total of 12 months was required to complete this job, from the time that a cost study was started until the last rectifier was in operation. It is estimated that the yearly charges, including power and operating costs plus the yearly charges for investment and depreciation reserve, will amount to approximately $13,000, and that something in the neighborhood of $50,000 on repairs will have to be spent in the next 10 years to put the system in good shape. It is reasonable to assume that at least the same expenditures on repairs would be made if no cathodic protection was applied. In any case, it should not be charged against the ca-

This article is adapted from a talk presented at the 1955 AGA distribution conference.



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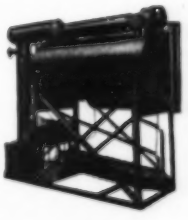

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Distribution system protection... Better coverage of mains involved can be attained with rectifiers

thodic application. If this premise is acceptable, then the $13,000 yearly costs are the equivalent of the yearly charges on about $140,000 of investment on replacements for this system. Unquestionably, more replacement than this would be required in the next 20 years, the estimated life of rectifiers and ground bed.

A cost justification on a job of this nature can be much more in detail and far more elaborate; however, the necessity of presenting more figures to justify a job as apparent as this is questionable. Certainly it has not been found necessary to do so in the Northern Illinois Gas Co.

In general, rectifiers have been used on supply mains because they are located in rural areas and because it is believed that better coverage of the mains involved can be obtained. Anodes are utilized on any supply main that, because of its proximity to other utilities, might result in interference if a rectifier were used. As a matter of interest, 110 rectifiers are now in operation in the company, 98 on gas mains and 12 on underground high pressure storage fields and underground propane tanks.

• Protection by cathodic application to as much of the existing distribution systems within town boundaries as possible with consideration being given to economic justification and the practicability of such an installation.

The third step in the original program, the protection by cathodic application of the distribution systems within town boundaries, was approached with much more caution. There was about 15 million ft of steel main and at least twice that amount of

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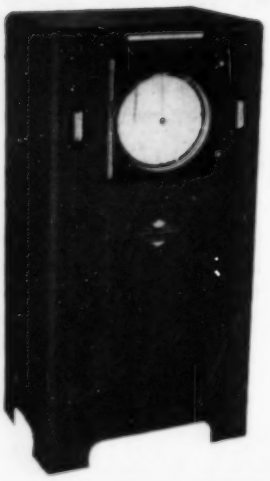

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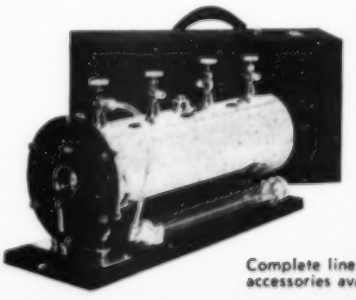

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. . . Distribution system protection

steel service pipe to consider, located in grown up areas with improvements completed or near completion. Most of the pipe was sized correctly, but the age varied all the way to 40 years. Therefore, the condition of the main was a big factor in the ultimate solution of the protection problem. The manpower required for this type of job was considerably more because every service had to have an insulating feature ahead of the meter in addition to insulating flanges to isolate the main into reasonably sized sections. Also, because of the proximity of other utilities and lack of good coating on all of the pipe, more trouble could be expected from shorts and unknown contacts with water pipes and other underground installations.

As expected when the program of protecting the small distribution mains was embarked upon, difficulty was encountered with coordinating the various phases of the job. Seven years of experience, during which cathodic protection was applied to 1,884,660 ft of steel pipe out of the 15 million ft mentioned above, brought out the fact that our primary mistake was in attacking sections that were too large. Some of the individual projects involved as many as 3200 meters. The installation work in customers' homes, which was done by fitters, had to be sandwiched in with the other work load in the area, and while the actual time of installing the insulating couplings was not excessive, we encountered the usual problems incident to breaking into piping in older homes. As a result, it was difficult to coordinate the work being done by the fitters with the installation of the anodes by a private contractor.

Efforts are now directed to small sections at a time. As an example, if an extension is being made from an older section of the system, the insulating flange will not be located at the beginning of the new construction, but rather back on the old system at a strategic spot to include 2000 or 3000 ft of the old main with as many as 50 services. A better over-all job at less cost is accomplished in this manner. By a careful choice of sections, the fitter's work can be spread over the company, rather than on one local organization as it was when larger sections were worked. Also, the engineer finds it easier to do the field checking after the installation is in service, with the result that less time per unit is required for a thorough job. This may not seem important, but experience has established that the success of this type of operation is very dependent on the thoroughness of the field check; anything that can be done to simplify this operation is worthwhile.

• Study and analysis of the stray current areas to effectively control their drainage.

The problem of stray current with its benefits as well as ill effects was not of first consideration, but it was of such magnitude that it could not be neglected. It had to be coordinated with all of the other corrosion mitigation work being done. The distribution system of Northern Illinois, bordering on the limits of Chicago, had practically no mechanical ties with other underground facilities inside of the city. For this reason, all of the stray currents from street car lines operating in the fringe areas of the city had to be controlled without

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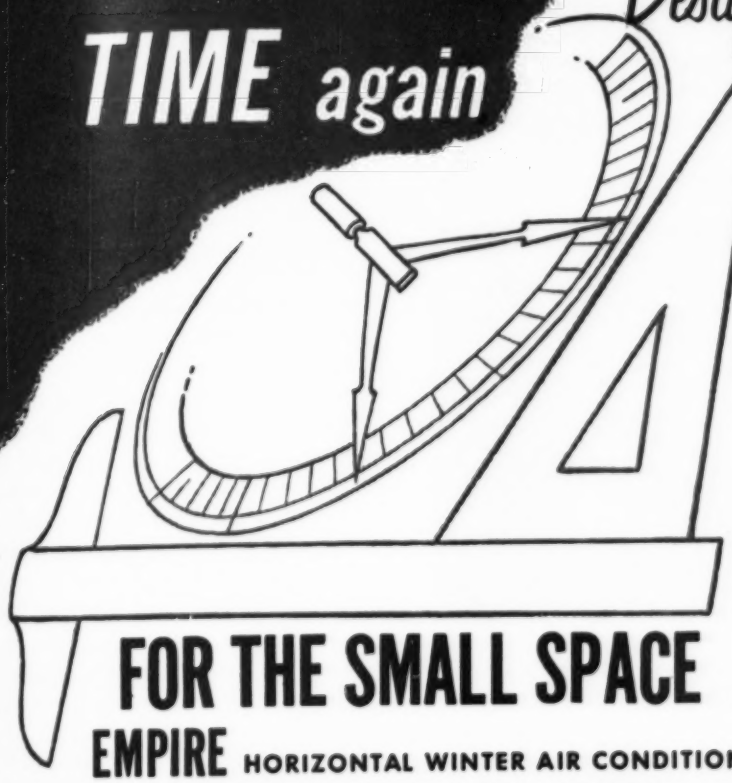

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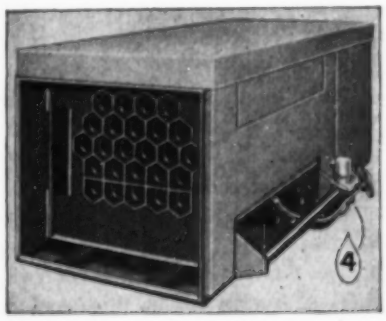

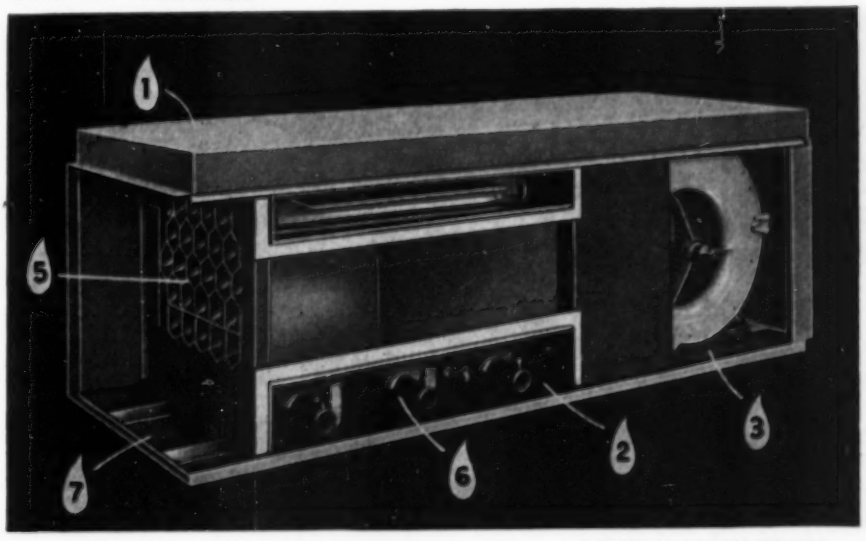

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...Distribution system protection

recourse to cooperative efforts of the street railways. Where other underground facilities were involved with the same problem, such as oil lines, electric underground and telephone cables, tests were conducted jointly and effective controls were put in service by mutual agreement.

Fortunately, the effects from fringe areas and suburban street car lines have about disappeared with the conversion to buses. However, three electric suburban lines are still operating, and offer serious problems of control for all underground structures outside of the city.

This phase of corrosion control has to be kept under close observation continually to adjust for changes not only at the source, but changes caused by improvements and additions to the company's gas system and the systems of those with whom the cooperative efforts were made.

Our corrosion engineering organization is a section of a centralized engineering department which performs all the engineering functions of the company. At present, the corrosion organization consists of a corrosion engineer, assisted by three engineers, two non-technical men, and a clerk. One engineer devotes his entire time to the problems of main replacements; it is his responsibility to evaluate and make studies and recommendations on all replacements requested by the operating organization. A second engineer is occupied full time with the operation and maintenance of rectifiers and drainage switches, making all necessary field checks of such installations to determine the effectiveness of their operation. A third engineer handles all of the design problems involved with cathodic application to new construction and to old distribution supply mains and systems.

The corrosion section has under its direction a truck fully equipped and manned to make installations of anodes, rectifiers, ground beds, and insulating flanges. One of the non-technical men referred to above is assigned primarily to the activities of this truck and crew.

The second non-technical assistant follows up on all anode installations on new construction and makes the first check in the field after construction to determine whether the installation is operating as designed. The clerk keeps all office records and maps up to date and assists in the routine designation of cathodic requirements on new construction.

The problem of checking the operation of anodes periodically (about every two years) has been solved by placing this work in the hands of the leak inspectors of the operating organization. Some consideration was given to organizing a group in the corrosion engineering section to do this work, but since leak inspectors covered this very territory on their patrols and already had the necessary transportation, it was decided to provide them with the necessary equipment and training to take the readings. This has the added advantage of maintaining the interest of the operating forces in the cathodic protection facilities located in their area.

Eight years of experience is not sufficient to make a definite statement as to the effectiveness of the protection being provided for new distribution construction. A thorough check made recently with the operating forces and the leak records revealed that failures on new construction due to corrosion

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PREFABRICATED STEEL VAULTS

For Parkway and Roadside Installations

Save time—save money.

Installed in a few hours instead of days.

Last as long as the pipe lines they serve.

Watertight—continuous welds.

Heavy construction to withstand frost action and ground water pressure.

Full opening for servicing when center beam is removed.

No forms to build—no waiting for concrete to set. Complete jobs cost less.

Stock pile these prefabricated vaults for immediate use.

Back hoe is all you need to install this Wachs Prefabricated Vault.

Drop it in the ground and it is ready for installation crews to set up equipment.

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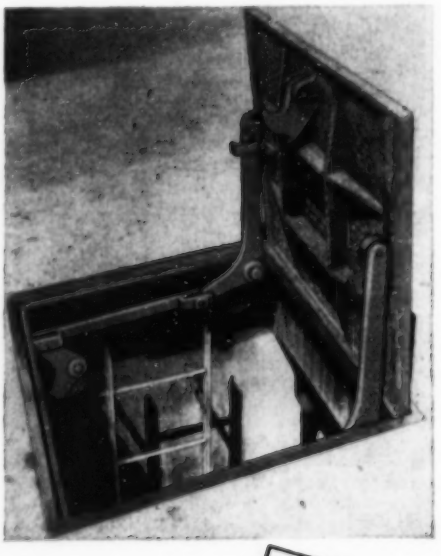

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Caloric PALM SPRINGS new 40" range
With automatic oven timer, extra large "Harvest" oven and Roto-Ray Barbequer. Also available with 6 top burners, 2 ovens and Lo-Broiler.

Caloric WHITE SANDS new 36" range
With automatic oven timer and with both full-size oven, "Pastry" oven and Lo-Broiler, or one oven and Ultra-Ray Hi-Broiler with Roto-Ray Barbequer.

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With automatic oven timer, 20" "Harvest" oven, and full-size Lo-Broiler, 4 top-burners.

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THE SENSATIONALLY NEW
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THERMO-SET GAS TOP BURNER

ON HER NBC-TV NETWORK SHOW HOME

For your biggest Fall Season—meet the demand she's creating for modern cooking's most spectacular advance with this master line of all-new Caloric gas ranges

This wonderful automatic feature makes all cooking fool-proof. Your customer need only set the dial to the desired temperature (just like an oven control) and the miracle THERMO-SET top burner does the rest. The THERMO-SET Sensing Element keeps the temperature of her pot or pan just where she wants it..automatically! No burning! No scorching! No boil-overs! It's just one of the many years-ahead automatic features of the colorful Caloric gas ranges.

Others are the In-a-line timer with bell, oven indicator light, timed appliance outlet and "matchless" performance. And for year-around rotisserie barbecuing, there's the famous Caloric Roto-Ray Barbequer.

Distinctively styled by Peter Müller Munk Associates, the new Caloric gas ranges have angled panel controls and smartly designed backguards with indirect fluorescent lighting in four glowing pastel hues.

Yes, for up-to-date automatic cooking conveniences, the call's for Caloric, now, more than ever, America's easiest range to keep clean.

CALORIC APPLIANCE CORPORATION, Topton, Pa.

Ranges • Built-Ins • Dryers • Disposers

Guaranteed by Good Housekeeping

As presented on HOME

maintains fast "work-and-run" schedules

CHECK THESE ADVANTAGES:

- ☐ 12.6 mph mobility on rubber
- ☐ automotive steering
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- ☐ digs up to 14½ ft. per min.
- ☐ 8 to 16 in. wide, 5 ft. deep
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- ☐ easy-insert "Tap-In" teeth
- ☐ shiftable, reversible conveyor
- ☐ 43.6 h.p. gas engine
- ☐ 6-ft. backfill blade (optional)

Parsons rubber-tired 88 Trenchmobile is the low-cost answer on widely-scattered, small-yardage trenching jobs, where it costs more to move big equipment in and out than it does to move the dirt. This mobile trencher drives cross-town at 12.6 m.p.h. . . . digs house-to-street service connections at speeds up to 14½ feet per minute... drives on to next job without delay.

With its 8 to 16-inch cutting widths, and maximum depths of 5 feet, Trenchmobile is also big enough for main line excavations. It saves a lot of costly hand clean-up, too . . . undercuts sidewalks, curbs, gutters, mains . . . makes vertical set-ins flush with foundations . . . backfills its own trench (blade optional). Get the complete story from your Parsons distributor, or write us.

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CITY, STATE _____

P466 GAS

PARSONS Trenchmobile

(Koehring Subsidiary)

...Distribution system protection

are not occurring today as they were when coating alone was the only protection. It is reasonable then to conclude that the small expenditure being made on new construction for the added protection of a cathodic application is justified.

Experience bears out the fact that corrosion can be arrested on bare or poorly coated steel mains located in rural areas by the use of rectifiers. Even though the job of cathodic protection is not quite comparable to that applied on a new main, it still is economically sound to apply cathodic protection to any steel main in this category which is in reasonably good condition and of sufficient capacity. No set formula can be applied universally to arrive at a decision; each case must be considered on its own merits and judged according to its particular location and condition.

Cathodic protection systems for distribution within town boundaries and in built-up areas are relatively easy to design, but difficult to accomplish with any degree of speed. The work load of the fitter organization must be taken into account when planning any program. Field checking such an installation after completion is considerably more difficult and time consuming, but absolutely necessary to assure success. Costs are higher than they are on new work; yet the savings made on fixed charges, by adding only a few years to the life of the main and services involved, should more than pay for the total cost of their cathodic protection.

Stray currents may very well be considered as "free protection" only if they are constantly kept under control. Fortunately, instruments and equipment to adequately do the job are now available. All that is required is the know-how which stems from experience.

The engineering required for designing cathodic protection on new construction is almost routine if all facilities are coated. Engineering personnel for cathodic protection work (other than new construction) should be geared to the size and type of the system involved and to the urgency of application. Based on our own experience, an approximate estimate of engineering personnel required for the job is one engineer and one non-technical assistant for every 100,000 meters. ■

Boiler market opened to industrial salesmen in the Northwest

Gas utility salesmen in the Northwest are chafing at the bit to get at the new markets that will open up with the arrival of natural gas. One of the richest areas for industrial salesmen will be in the field of boiler conversions. Heretofore, oil has had the inside track so the characteristics of this fuel application may be a somewhat unknown quantity among most industrial gas men in the region.

"The application of natural gas to industrial boilers will introduce a variety of problems, but these problems can be overcome," is the assurance that L. S. Reagan has been giving these salesmen in recent weeks. Mr. Reagan, who is vice president of Webster Engineering Co., Tulsa, has been making the rounds of the Northwest to educate industrial salesmen on applications and equipment.

The following pertinent paragraphs intended to acquaint the salesman with some of the more frequently encountered installation and trouble-shooting difficulties, are excerpted from Mr. Reagan's talks.

¶ Attempts to increase the output of a boiler by raising the gas pressure may result in incomplete combustion and formation of CO. The presence of CO has a profound effect upon efficiency. A concentration of only 0.1% of CO can reduce efficiency by as much as 5%.

¶ Boiler operators who have been accustomed to oil firing are sometimes afraid that their brick work is about to melt when they change over to gas firing. The fact that gas burns with a clear and almost invisible flame enables them to see the brick work properly for the first time. In actual fact there is no danger of damaging the boiler setting.

¶ When a boiler has been operated on fuel oil for a long period of time, the breeching must be cleaned to remove any residues that may have accumulated. If this is not done they may burn or explode after conversion to gas firing. The same precaution applies to the removal of fly ash from a coal-fired boiler because the fly ash usually contains a proportion of soot that will support combustion.

¶ Immediately after conversion to gas, a boiler that has been fired with oil may show apparent hot spots on the tubes that might suggest that blistering is taking place. This is usually nothing more than a process whereby the oily residue is being burned off without any harmful effect. The gas fire actually cleans the boiler. If the boiler were previously coal-fired, there may be deposits of slag, which will melt and damage the brick work. In some cases large pieces of slag may break loose and fall with resulting damage. It therefore follows that slag should be removed before firing with gas.

¶ It is a good rule not to attempt to develop more than 10 hp per square foot of projected surface exposed to the fire. Higher rates may cause steam pockets, which break circulation and cause blistering. Oil in the feed water will also cause blistering.

¶ An experienced oil burner man can judge the percentage of CO_2 in the flue gases from the appearance of the flame. This is quite impossible in the case of

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It's no secret that Lancaster Groove Type Metal Rim Diaphragms stay in the meter longer . . . and assure sustained accuracy in gas measurement year after year. Send for a sample today.
New — BETTER SEALING
Now Lancaster offers Buna-N-Cork Meter Gaskets for better sealing! Test it in your shop and see how it solves the problem of an occasional leaking gasket. Send for a sample today.
METER PARTS CO.

a gas flame where flue analysis is necessary.

¶ It is important to size burner equipment to suit the load. It is poor economy to put in greater capacity than is required. Horizontal return-tube boilers can be operated effectively at between 100% and 125% of their ratings. Water-tube boilers may be operated up to 200% but remember that efficiency will be low when turned down. It is better to install a small burner and make provisions for the addition of another rather than put in larger equipment and operate it at less than its full rating.

¶ Draft losses must be carefully worked out to make sure that the available draft is sufficient to overcome all of the losses and still provide all of the air required for complete combustion. There must be unrestricted openings in the boiler room walls, not less than ½ sq ft per million Btu per hour; ¾ sq ft is even better. Remember that gas burners depend on natural draft to supply the air and this air must have free access to the burner equipment. Look out for boiler room exhaust fans. These may be strong enough to cause the flame to blow back during light-off. It may be necessary to shut down the fans or modulate them in some way.

¶ Unless there is a willingness to spend plenty of money on the very best controls, it is not wise to attempt to operate at the ultimate CO_2. There is too great a danger of forming CO with resulting loss of efficiency far in excess of the loss that would be suffered by attempting to operate at a little lower percentage of CO_2.

¶ Draft fans are very frequently oversized and this makes their control difficult because very minute changes in the controlling elements produce relatively large changes in draft.

¶ If a wide range of turn-down is required, it is necessary to use gas at several pounds pressure. The gas input varies as the square root of the pressure so that if a turn-down ratio of 5 to 1 is desired, the corresponding pressure ratio would be 25 to 1. If the gas is supplied at 6 in., it will readily be seen that this ratio of turn-down is impossible because the equipment could not operate at a pressure of ¼ in.

¶ Control valves must be sized on the basis of the pressure ahead of the valves and not according to the sizes of the pipe and burners following the valves.

¶ On boilers or appliances generally in excess of 400,000 Btu per hour, the thermocouple type of safety pilot is unsatisfactory. The flamerod or electronic type of safety pilot is a necessity. The safety pilot should be an integral part of the burner so that it is always maintained in correct relationship. Attempts are sometimes made to install safety pilots through separate openings in the brick work but this introduces the hazard that the safety pilot might be unable to provide positive ignition to the main burner.

¶ Where the boiler is supplying a turbine or engine, it is unsatisfactory or even hazardous to control the entire gas supply with one safety pilot. If the gas supply is suddenly shut off, the boiler may send over a slug of water, which will wreck the turbine. A separate safety pilot may be applied to each burner, or better still, since such a boiler would be constantly attended, install a bypass

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"My new Ruud laundry-rated Alcoa® Alloy water heater really keeps up with my automatic washer!"

Now . . . sell *every* housewife on a water heater that meets all the demands of her automatic washer, whatever the make—no matter how many consecutive loads she washes. Now . . . sell the first and only water heater with a solid Alcoa Aluminum Alloy tank—at a price comparable to ordinary water heaters with lined-steel-type tanks.

And get this! The new Ruud Laundry Rated Alcoa Alloy automatic gas water heater has an optional duo°°temp feature—delivers TWO temperatures of hot water from the same tank at the same time! 180°extra-hot water to maintain in-the-washer temperatures of 150°-160° for whiter, brighter washes. 125° tempered-hot water for baths, lavatories and other general-use outlets as recommended by the National Safety Council.

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RUUD GAS WATER HEATERS

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around the safety shut-off and use the safety device only during the period when the boiler is being started up because experience has shown that 89% of explosions occur during light-off. When the boiler is in normal operation gas is fed through the bypass and an alarm system warns the attendant of the failure of any burner so that remedial action can be taken without the aforementioned risk of shutting down the fire and sending over slugs of water. An alarm system on the incoming gas supply is also recommended to warn of falling pressure. ■

GAS associations

Gas will occupy largest exhibit at metal show

Once again the industrial and commercial gas section of the AGA will sponsor the largest single exhibit of the 37th annual National Metal Exposition and Congress to be held Oct. 17-21 in the Convention Hall and Commercial Museum in Philadelphia.

Nine exhibitors are cooperating in this annual show to demonstrate the many uses and importance of gas fuel in the metalworking industry. How industrial equipment fits into the production line as a tool will be one of the points featured in the AGA gas area.

The 19th annual Industrial Gas Breakfast will be held on Wednesday morning, Oct. 19, in the Pennsylvania room of the Penn-Sherwood hotel.

Committee meetings of the groups identified with industrial gas activities will be held on Tuesday and Wednesday, Oct. 18 and 19, at the Penn-Sherwood.

Atlantic City chosen for AGA's 1958 convention

The executive committe of the AGA hts voted to hold the 1958 annual convention in Atlantic City, in the week of Oct. 12. Members of GAMA are expected to vote early in 1957 as to whether an exhibit of gas appliances and equipment will be held in conjunction with the 1958 convention.

Previously it had been decided to hold the 1956 convention of AGA in Atlantic City the week of Oct. 15 and to hold the 1957 convention in St. Louis, Mo. Oct. 7-9.

GAS association notes

Harold E. Peckham has resigned as secretary-treasurer of the Mid-West Gas Association after eight years in the office. Everett E. Baxter, Central Electric & Gas Co., Lincoln, Neb., has been elected to fill the unexpired portion of Mr. Peckham's term of office. His new duties as general superintendent of gas operations in Northern States Power Co. make it impossible for Mr. Peckham to continue as secretary-treasurer of the association.

Annual meetings of GAMA will be held at the Greenbrier, White Sulphur Springs, W. Va., for the six years, 1956-1961. Dates tentatively scheduled are: April 19-21, 1956; April 8-10, 1957; April 2-4, 1958; April 1-3, 1959; March 30-April 1, 1960; and April 5-7, 1961.

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regulation is in the plans.
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With the help of an elf, she takes from the shelf
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for rush shipment all over, you know,
A complete range of sizes with 3" the largest
they feature advanced
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Spend just 3c, so from this day hence
a catalog will be within reach.
When you need a large size, you'll soon realize
that Maxine is truly a peach.

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It's here—ready to work for you! JOHN WOOD has a water heater story that's a natural for sales! BY ACTUAL TEST, John Wood Water Heaters cost your customers less per gallon for hot water ... make *savings no other construction can match!* That's because the OFF-CENTER flue construction—developed and featured by JOHN WOOD—beats every known water heater construction for economy in test after test.

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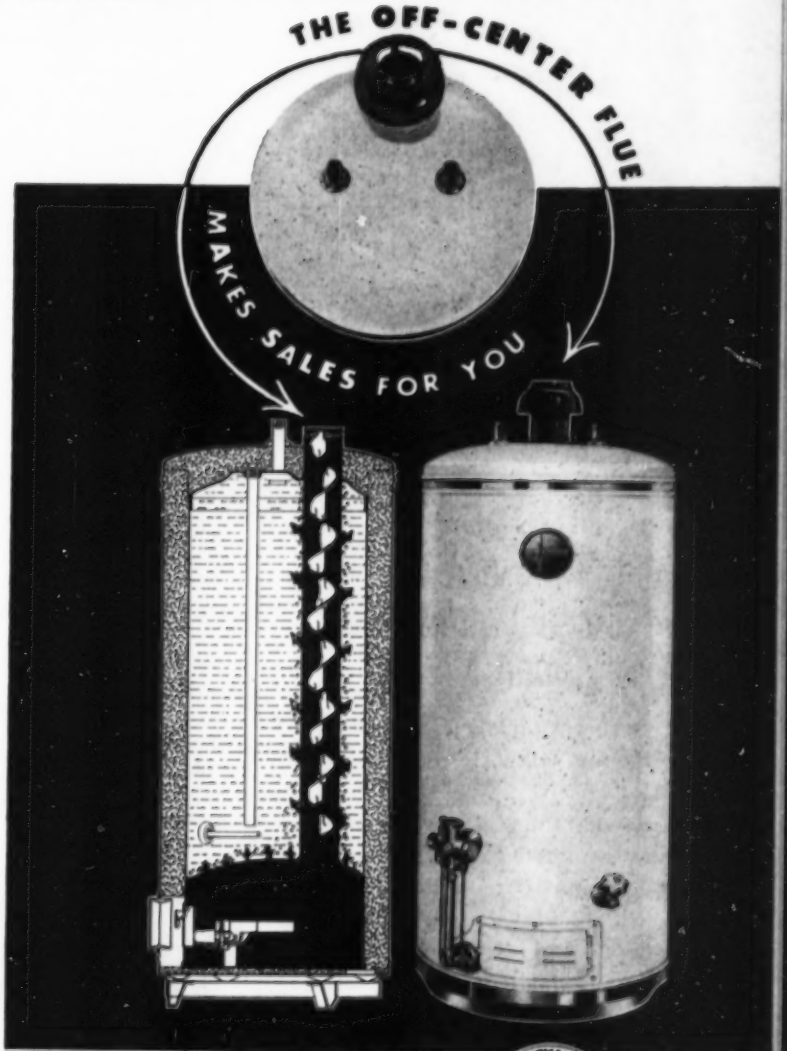
Here's potent sales material—backed up by the hardest hitting program of promotion and advertising yet—*all working for you and your bigger profits.*

Ask your JOHN WOOD representative for the full story.

Write for FREE Book "How Do You Judge a Water Heater"—Today!



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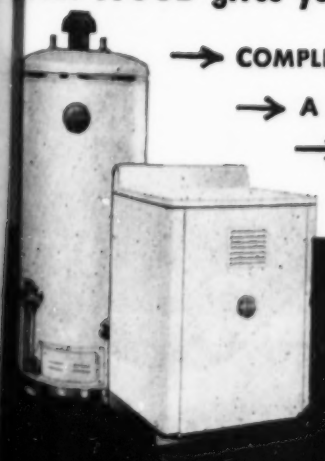

- → COMPLETE LINE of sizes and styles, vertical and table top models
- → A PRICE FOR EVERY BUDGET
- → THE ONLY WATER HEATER OFFICIALLY SELECTED BY *Mrs. America*
- → FULL PROMOTIONAL HELPS to build your sales

Finest glass-lined or galvanized water heater anywhere!

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BUCKEYE
MODEL 403
for Service Lines
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Small Mains

Here's the *first* and *only* low-cost production ditcher designed especially for service line work! . . . Digs flush with foundations and obstructions; eliminates hand finishing . . . Exceptionally maneuverable and highly mobile — *plus* fast ditching ability . . . Digs ditch 8", 10" or 12" wide to 5' depth; 14" or 16" wide to 4' depth.

WORKS UNDER ADVERSE CONDITIONS . . .
Full crawler mounted for high flotation and maximum traction with low ground-bearing pressure.

EASILY TRANSPORTED . . .
Small size and low silhouette permit fast job-to-job travel on small tilt-bed or flat bed trailer.

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Both fixed and variable load functions covered in new AGA appliance regulator requirements

Today, millions of gas pressure regulators are to be found on a wide variety of gas appliances. They are universally used on approved central heating equipment and are being used in increasing numbers on domestic gas ranges, water heaters and other household gas equipment.

Their use on gas equipment permits the appliance designer to design for close operating tolerances. Appliances incorporating pressure regulators provide the manufacturer a means to adjust and preset the appliance for proper input rating, through use of fixed orifices, before it leaves the factory. This minimizes field adjustment and installation time and increases customer satisfaction.

Design progress

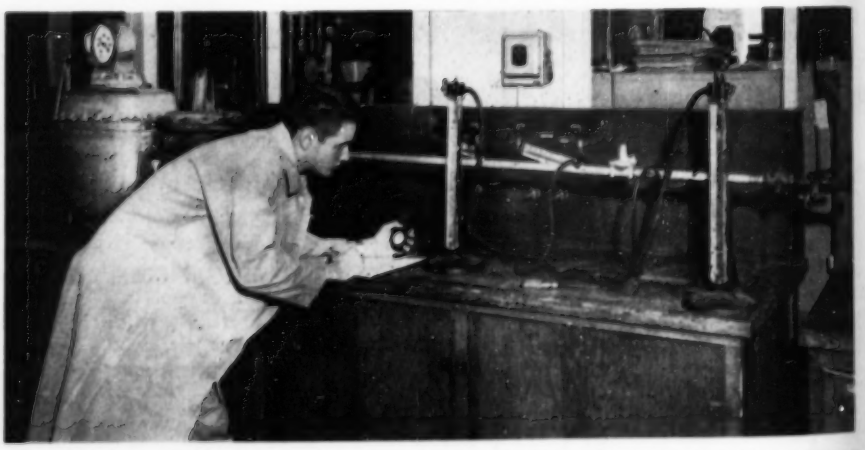
Existing standards for gas appliance pressure regulators were developed in 1934. Since that time considerable design progress has been made. Regulators of smaller sizes with improved operating characteristics have evolved. Likewise, the application of pressure regulators has changed. A recent survey among appliance manufacturers indicated that approximately 60% of the regulators used on gas appliances were not required to control pilot flow, but operated at a fixed flow rate corresponding to the rating of the appliance.

To bring the industry standard for pressure regulators up to date, the subcommittee on listing requirements for domestic gas appliance pressure regulators recommended that a number of major revisions to the existing standard be made. In addition, the subcommittee believed that the dissemination of information not heretofore published by the AGA Laboratories on the operating characteristics of pressure regulators would be of assistance to appliance designers in making proper selection for a given application.

Endorsement

The subcommittee's recommendations were endorsed by the ASA Sectional Committee, Project Z21, AGA Approval Requirements Committee, to become effective Jan. 1, 1956. The revised requirements have been submitted by the sponsor, the American Gas Association, to the American Standards Association for approval as American Standard. Following the effective date all domestic gas appliance-type regulators submitted to the AGA Laboratories for listing tests will be checked under this revised standard.

An ideal gas pressure regulator at any given diaphragm loading (spring setting) would hold the downstream outlet pressure constant for a range of flow conditions and over a prescribed range of inlet pressures, once the inlet pressure is equal to or greater than the outlet pressure setting of the regulator. While contemporary regulators approach a straight line outlet pressure characteristic over the designed range of operation, some deviation from the ideal performance will occure. The test procedures specified by the revised standard are designed to determine the deviation and establish the practical range of acceptable operating charac-



AGA Lab engineer checking the performance characteristics of a domestic gas appliance pressure regulator under new American Standards to become effective Jan. 1, 1956.

teristics which will provide satisfactory control of the gas pressure applied to the burner of a gas appliance. The standard includes specifications covering the construction of the device as well as extensive performance tests.

Since approximately 60% of the pressure regulators in use today are not required to control pilot flow but operate at a single flow setting corresponding to the input rating of the appliance, requirements for two distinctly different types of application have been developed. These two types may be considered as (1) a fixed load-type application and (2) a variable load-type application.

With a fixed load-type application the regulator when installed on an appliance is called upon to respond to variation of inlet pressures in such a manner as to maintain constant outlet pressure, at a given input rating. This application is represented by the major heating equipment class wherein the regulator does not regulate pilot flow.

Wide range

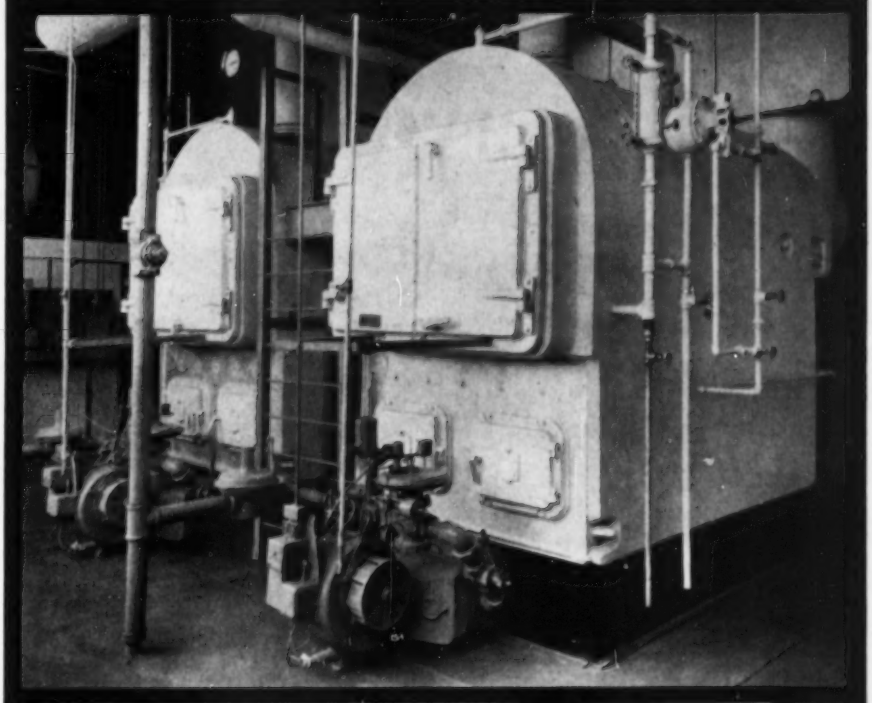
With the variable load-type application the regulator is required to control outlet pressure over a wide range of flow conditions ranging from and including pilot flow to the total rating of the appliance; an obvious example is a gas range. With this type of application the pilot take-off is at the outlet or down-stream from the outlet of the regulator. Accordingly, all regulators tested by the AGA Laboratories under the revised standard will be tested for fixed load-type application. When a regulator has been designed for fixed load-type application, additional tests will be performed for compliance with the standard upon request of the manufacturer.

Since the revised standard covers only pressure regulators designed for application to individual appliances, they have been keyed closely to the approval standards for gas equipment. Appliance regulators listed under the new standard will be suitable for use with inlet pressures up to 13.6 in. wc. This range of inlet pressures is in line with the scope of the American Standard Installation of Gas Piping and Gas Appliances in Buildings, Z21.30-1954, which limits coverage to "low pressure —not in excess of ½ lb per sq in."

Normal design

A comprehensive study of the laboratories' test records indicated that approved appliances are normally designed for operation with a regulator outlet pressure between 2- and 4-in. wc. Thus, the revised standard limits the outlet pressure adjustment range to

Mettler "FAN-AIR" Gas Burners chosen for unusual boiler installation



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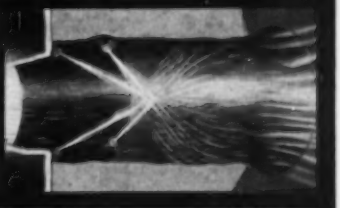
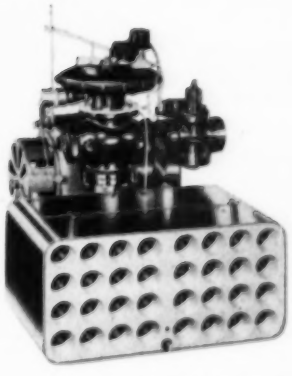
Unique Mettler "ENTRAINED COMBUSTION" design. Wide "turn down range" without backfiring. Four orifices per port (instead of the usual one), means top efficiency. Orifices are replaceable, too.





Functional use of color improves working conditions and actually makes this boiler room an attractive "show place." Choice of "FAN-AIR" Gas Burners for the boilers upgrades working conditions, too, because they're quiet . . . clean firing . . and safe! Safety is a standout feature of Mettler Burners. Their exclusive pilot rectification control system is a newer, more advanced method of safeguarding burners. Another "FAN-AIR" *first* is replaceable gas orifices . . . a feature that permits engineering the size of the orifice to each job, matching available gas pressure to desired input for ultimate in air-gas mixing. This gives you completely flexible application (with mechanical or natural draft) and maximum *efficiency* . . . at real money saving low cost.
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Brooklyn 17, N. Y.
Cable Address GASTOPPER, N. Y.

Appliance regulator requirements

a range of outlet pressures above zero but not to exceed 6-in. wc. This range of outlet pressure adjustment is in keeping with contemporary appliance regulator designs which normally range from 2 to 6 in. The performance of the regulator will be checked under these standards at the midpoint between the maximum and minimum of the adjustment outlet pressure range. Tests are to be performed using a number of inlet pressure conditions and various flow rates sufficient to determine that the outlet pressure provided by the regulator will be within acceptable limits and suitable for use on a wide variety of gas appliances.

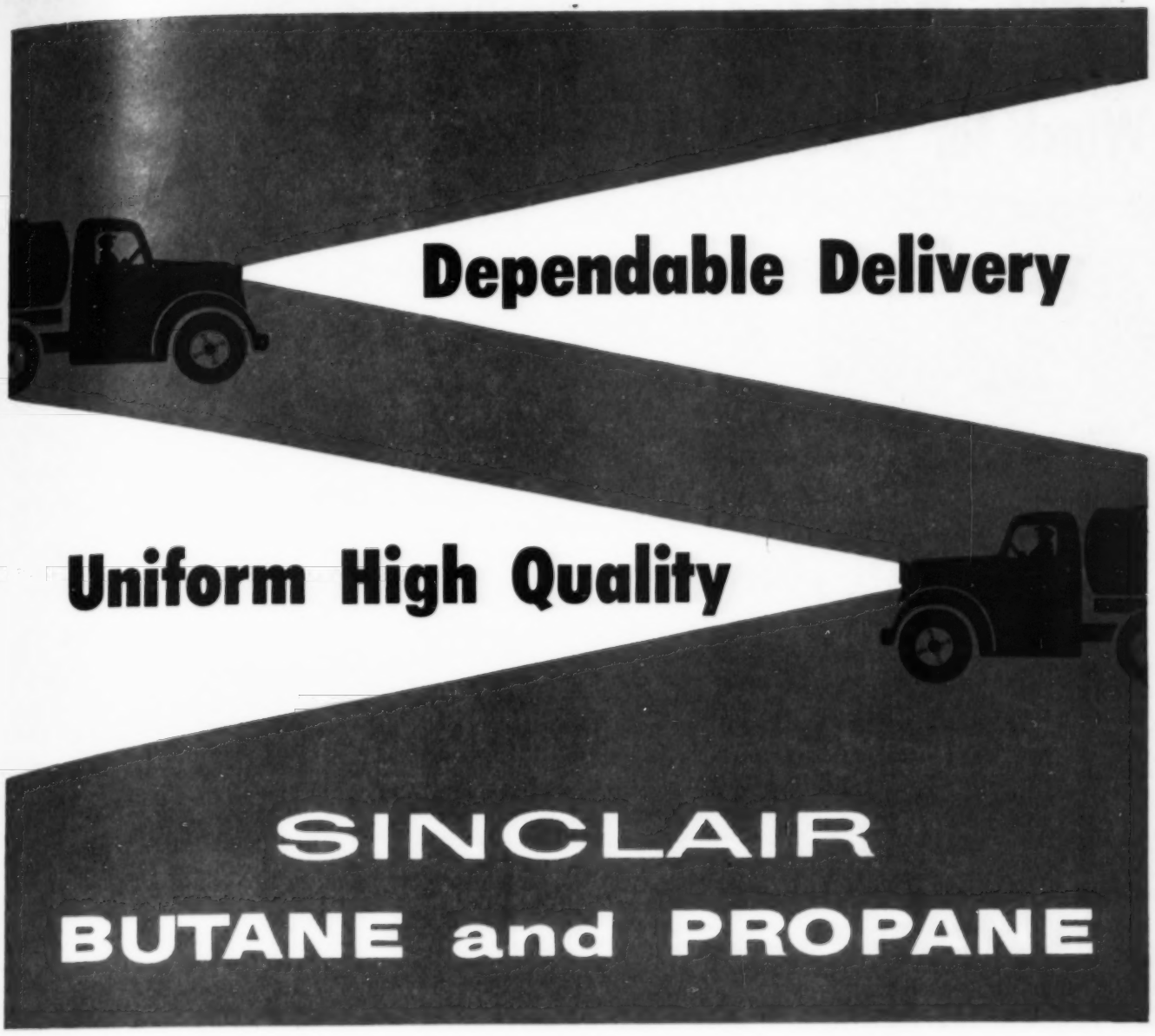
Performance characteristics

Under this standard the laboratories will determine a number of important performance characteristics which are of value to the appliance designer in selecting a regulator for a given application. These characteristis are (1) the outlet pressure adjustment range, (2) the pressure drop capacity at 0.3-in. wc, (3) the maximum and minimum regulation capacity for a fixed load-type application, and (4) the regulation capacity, if tested for variable load type application. Data on these important operating characteristics will be published in the AGA Laboratories Directory of Approved Appliances and Listed Accessories for regulators tested under the new requirements.

The pressure drop capacity figure published in the laboratories directory will be the flow rate for a loss in pressure equal to 0.3-in. wc when the valve of the regulator is in the wide open position. This figure serves as the basis for determining whether the total pressure drop for a control system will be within the limits specified by the appliance standard. In line with present practice, pressure regulators may be used in the control system at flow rates giving a pressure drop greater than 0.3-in. wc, provided that (1) the flow rate does not exceed the flow rate for which acceptable regulation was obtained and (2) the total pressure drop in the appliance manifold does not exceed that allowed in the appliance requirements.

Maximum flow rate

The regulation capacity for a fixed load-type application will be the maximum flow rate for an inlet-outlet static pressure differential of 1-in. wc at which pressure regulation is acceptable.



● Reliability of supply is of prime importance to users of LP Gas. And over the years they've learned they can *depend* on Sinclair's vast production and distribution facilities to meet LP supply requirements . . . *where* and *when* these supplies are required.

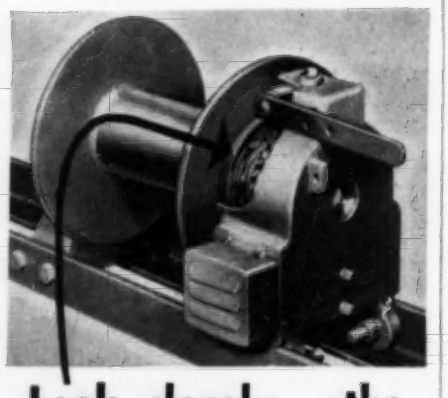
Moreover, Sinclair LP is the gas with high heating value . . . with moisture and impurities removed. Its uniform high quality means more efficient, trouble-free operation from your LP Gas installations. You can use Sinclair Butane and Propane with confidence.

To assist you in solving any problems involved in your Butane or Propane installations, Sinclair engineers are at your service. Get the full story on how it will pay you to specify *Sinclair* by calling or writing to . . .

SINCLAIR
A Great Name in Oil

Sinclair Oil and Gas Company
Liquefied Gas Sales Department
Sinclair Oil Building, Tulsa, Oklahoma

Here is the 7000-lb. Winch for you!



Look closely... the *Secret's Inside!*

Here, at last, is an improved light-duty Gar Wood winch that positively ends the old-time headaches of sticking, freezing, rusting — because all moving clutch parts are *fully enclosed and running in oil.* Neither weather nor dirt can ever get in. Your operator also has much *safer control of the load,* thanks to Gar Wood's exclusive self-energizing safety brake, and time-tested backdraft clutch, which eliminates the hazard of sudden slippage.

More GW plus values

New rust-proof aluminum housing means lighter weight, longer life... dissipates heat much faster than steel. In addition, extra rugged base angles insure a margin of safety many times the rated capacity of the winch. New "built-in" rope clamp also simplifies attaching and changing rope... eliminates U-bolts and other projections that tend to foul spooling. See these great new 7000-lb. winches – standard or low mount – at your Gar Wood distributor today.

GAR WOOD INDUSTRIES **GAR WOOD** *Winches*

GW-W-1r

— MAIL COUPON FOR QUICK ACTION —

Gar Wood Industries, Inc.
Main St., Wayne, Michigan

☐ Send free literature on new 7000-lb. Gar Wood Winch

☐ Std. Mount ☐ Low Mount

Name .....

Title .....

Company .....

Address .....

Appliance regulator requirements

Both the maximum and minimum regulation capacity figures will be published. The published minimum regulation figure will be equal to or greater than 10% of the regulation capacity. Regulators for use with fixed load-type applications should be selected for use on appliances having a fixed flow rate that is within the published maximum and minimum regulation capacity range; otherwise, unsatisfactory outlet pressure regulation is likely to result. Furthermore, the use of a pressure regulator at flow rates in excess of the published regulation capacity figures is not considered acceptable, nor the use of a fixed load type with pilot load.

Highest rate

For variable load-type application, the published regulation figure will be the highest operating flow rate for which outlet pressure regulation is acceptable following adjustment of an inlet-outlet static pressure differential of 1-in. wc. No minimum flow rate figure for variable load type application will be published. Such regulators, however, will have been tested for acceptable performance at a flow rate of 0.15 cu ft per hour of 0.7 specific gravity gas. A regulator listed for variable load-type application will provide satisfactory regulation from 0.15 cu ft per hour flow to the published regulation capacity for the regulator. This type of regulator can be identified in the field by the marking "VL" on the casing. It will be acceptable for application on domestic gas ranges or similar appliances where input may vary continuously or in steps from pilot rate to full input, where the maximum possible flow rate will not exceed the regulation capacity for the regulator, and where pilot load is involved.

Copies of the new standard are available in multilith form at 50 cents each. Printed copies will be available following approval of the standard by the ASA at a price not yet established. ■

Bring the Sun Indoors!

Your Plant can now have EFFICIENT, HEALTHFUL HEAT *silent and draft-free with*

PANELBLOC

INFRA-RED UNIT HEATERS

- Comfortably heats workers and machines within radiation area.
- Heat not wasted on air which would normally rise to ceiling.
- No fan, motor or electrical connection needed.
- Never shut down due to power failure.
- Heat delivery cannot be diverted by drafts from open doors.
- No moving parts . . . less maintenance.
- May be used with any commercial type gas fuel.

Remember how comfortable it feels to stand in the warm sun on a cold day? That's how Panelblocs work. Gentle, comfortable heat rays warm everything they touch. You have all the advantages of conventional heaters . . . none of the disadvantages.

Panelbloc uses no fan. This means no drafts (heating is accomplished by guided radiation). With no electrical connections, Panelbloc costs less to install—will continue to operate during a power failure . . . and it heats, not air, but personnel and equipment . . . anything solid.

Panelbloc may be installed in practically any type structure for general heating; for spot heating in an otherwise unheated building; for heating a single room . . . In fact, almost any heating requirement can be solved with Panelbloc. Available in two models: 62,500 btu and 125,000 btu input.

For warm air heating check the Prat-Daniel THERMOBLOC Heater . . . used the world over.

THERMOBLOC

Division of

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Send Me Panelbloc Bulletin P-154

Name_____ Title_____

Company_____

Address_____

GAS news

Eight Wisconsin utilities add 14,575 heating units

Wisconsin's Public Service Commission has issued a general order granting eight gas utilities the right to add an additional 14,575 new house heating customers to their natural gas lines, effective immediately. All of the companies are supplied by the Michigan-Wisconsin Pipe Line Co.

Milwaukee Gas Light Co. was given permission to add 8554 house heating customers, which will bring to 71,828 the number of natural gas home heating customers the company is permitted to service.

Other utilities granted increases, the amount of the increase and the new total of customers who will be served follow:

Wisconsin Natural Gas Co., 2117, 17,779; Madison Gas & Electric Co., 808, 6781; Wisconsin Power & Light Co., 946, 7946; Wisconsin Public Service Corp., 1669, 14,015; Wisconsin-Michigan Power Co., 290, 2434; Wisconsin Fuel & Light Co., 164, 1374, and Stoughton Light & Fuel Co., 27, 228.

The quota increases were granted by the PSC after Michigan - Wisconsin filed a new tariff with the FPC asking the connection of an increased number of space heating customers.

Peoples Water of Florida acquires Tampa Gas Co.

Tampa Gas Co., serving Florida's third largest urban area, has become a wholly owned subsidiary of Peoples Water & Gas Co. with general offices at Miami, according to P. C. Crowen, president of Peoples and of the Tampa company.

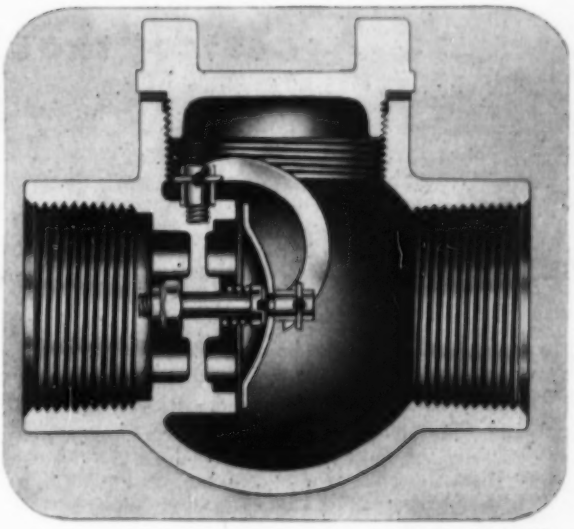
The Peoples system, including the Tampa operations, is the largest gas operation in Florida with a service gas population estaimated at 1.5 million. It is also the only gas utility system serving both the southwest and southeast coasts of the state.

Observers note that there may be a further public advantage in this fact as creating a possibility for cross-state in-

Only a CALLAHAN Back Pressure Control Valve Has This EXCLUSIVE NON-STICKING FEATURE

Illustration shows how patented push rod is mounted in web thru center of valve to prevent disc from sticking on the seat when no gas is flowing, or gas flow is decreased to pilot light operation.

Body of valve is designed for full capacity flow with minimum of pressure drop under normal operation.



Sizes ¾" to 4" have female pipe thread connections.

Size 6" and larger have flanges drilled to ASME 125 lb. standard.

All Valves Supplied With Aluminum Discs.

U.S. Patent No. 2514838

Prevents Dangerous, Costly Reverse Flow of Gas or Air

Back pressure valves are in general use to prevent reverse flow of high pressure air into gas mains when burner orifices become clogged or when the burner is closed without shutting off the high pressure air, often causing complete interruption of service in a locality.

Ordinary back pressure valves frequently stick when no gas is flowing or gas flow is decreased to pilot light operation due to oil or other foreign matter deposited on the seating surfaces of the valve.

This condition requires a service call and consequent delay and expense. It is here where the patented non-sticking feature of the Callahan Valve renders greater service, not only by preventing reverse flow of gas or air from entering the gas mains, but also a means for assuring a back pressure valve free from the inconvenience of sticking, and will not interfere with the normal operation of the valve by providing positive flow from minimum to maximum capacity.

Rugged Construction

These valves are of rugged construction and will withstand back pressure up to 125 pounds per square inch. Almost no maintenance or replacement is required. The essential parts are accessible for inspection without removing the valve from the line.

Complete Size Range Available From Stock

Catalog Number	Pipe Size	Type
101	¾"	BRONZE
102	1"	BRONZE
103	1¼"	BRONZE
104	1½"	BRONZE
105	2"	BRONZE
106	2½"	IRON
107	3"	IRON
108	4"	IRON
113	6"	IRON
114	8"	IRON
115	10"	IRON

Manufactured by

HENRY FLOW CONTROL COMPANY, INC.

SUBSIDIARY OF HENRY VALVE COMPANY

3215 North Avenue, Melrose Park (Chicago Suburb), Ill. • Telephone: Fillmore 4-4680

Sullivan

Dual Adjusta-flo

GAS CONTROL VALVE

For Increased EFFICIENCY, ECONOMY *and* SAFETY *in Gas Fired Boiler Installations in:*

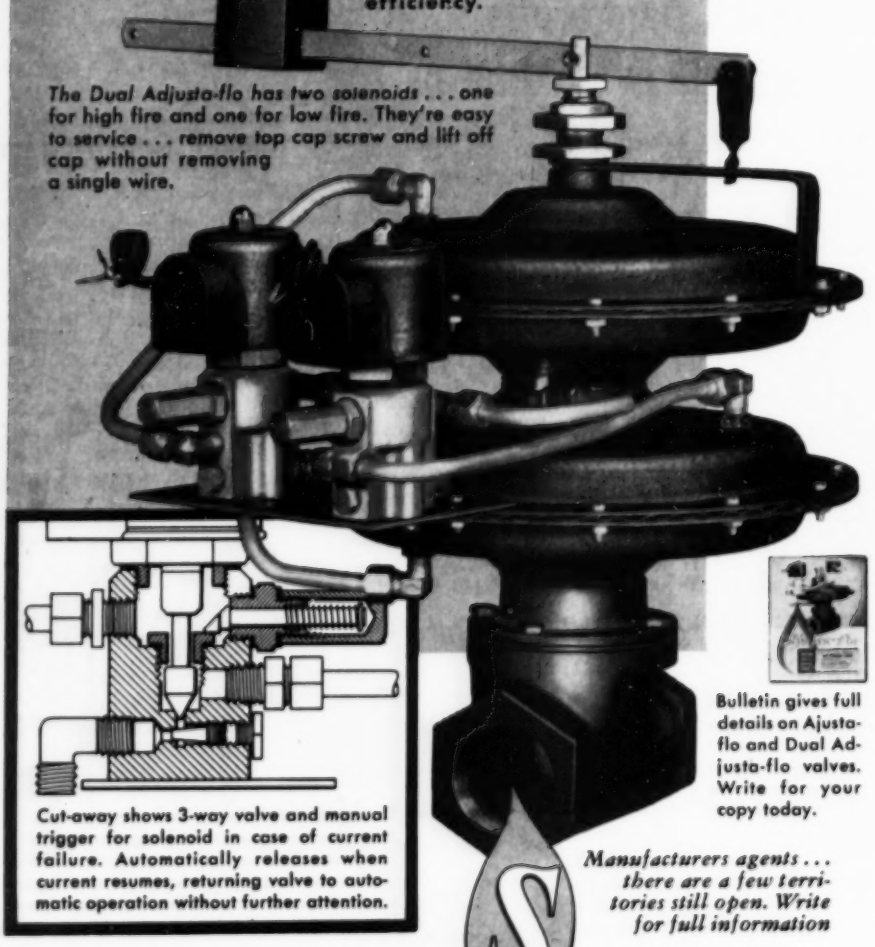
- HOSPITALS
- HOTELS
- LAUNDRIES
- DAIRIES
- APARTMENT HOUSES
- AUDITORIUMS
- OFFICE BUILDINGS
- SCHOOL BUILDINGS

Sullivan Valve and Engineering has pioneered in valves for automatic 2-stage firing boilers.

TWO OPERATING STAGES. The Dual Adjusta-flo gas valve features automatic control of the gas supply to the burners, providing an "off" position plus a "high" and "low" fire.

- Eliminates hazard caused by excessive volume of gas in a cold boiler and stack.
- Meets the demands of ordinary boiler operation yet satisfies the loads imposed by peak demands.
- Unobstructed gas flow lowers installation costs and increases operational efficiency.

The Dual Adjusta-flo has two solenoids . . . one for high fire and one for low fire. They're easy to service . . . remove top cap screw and lift off cap without removing a single wire.



Cut-away shows 3-way valve and manual trigger for solenoid in case of current failure. Automatically releases when current resumes, returning valve to automatic operation without further attention.

Bulletin gives full details on Ajusta-flo and Dual Adjusta-flo valves. Write for your copy today.

Manufacturers agents . . . there are a few territories still open. Write for full information

SULLIVAN

VALVE AND ENGINEERING COMPANY

P. O. BOX 1391, DEPT. G-10, BUTTE, MONTANA

terconnection of the gas systems, particularly with the advent of natural gas in Florida.

An immediate program of modernization and improvement of the Tampa company gas generating and distribution system has been announced by Mr. Crowen.

It was stated that no changes are contemplated in the key personnel of the Tampa organization. P. C. Crowen is president, A. H. Stock of Tampa continues as general manager, and L. C. Jewett as treasurer. Mr. Jewett is also assistant secretary. Andrew B. Young, secretary of the parent Peoples company is secretary of the local company. John C. Bolender, operating vice president of Peoples will be operating vice president of Tampa Gas.

Oil-gas extraction process granted patent

The United States Patent Office has granted to Virgil Stark, president of North American Utility & Construction Corp., New York, a patent No. 2,714,060 issued on July 26, 1955 entitled "Process of treating oil gas to produce utility gas of low heat content and low gravity with valuable by-products."

This patent covers a process for combining the oil gas production from heavy oils with extraction and separation of hydrocarbons available in the oil gas, not only the benzol but also the lower hydrocarbons, such as, butylene, propylene, L.P. gas and even ethylene

Production of its half-millionth regulator was celebrated recently by Universal Controls Corp., Dallas. In commemoration of the event, Universal held a plant inspection and luncheon, at which the gold regulator was presented by Charles D. Peterson of Universal to Harold W. Johnston, general superintendent of the Gas Service Co., Kansas City, Mo.

if so desired. Extraction and separation are done essentially by compression and refrigeration.

The market value of the separated products, being much higher than the fuel oil, may cover most of the cost of fabrication. In this way the cost of the gas after extraction may be very low, even lower than natural gas, for certain market conditions.

The gas after extraction may be a perfect substitute to either natural gas or manufactured gas. The processing of the gas also results in its complete purification.

This process makes available an economic solution not only for stand-by and peakload for the natural gas supply but will also make it possible to obtain either gas or I.P. gas or certain chemicals at very low cost.

Safety Congress to attract 12,000 to Chicago

Safety men from all fields—industrial, traffic, farm, school and home—will converge on Chicago, Oct. 17-21, to attend the 43rd National Safety Congress and Exposition, the annual convention of the National Safety Council. Meetings will take place at the Conrad Hilton, Blackstone, Congress, La Salle, and Morrison hotels.

More than 12,000 persons are expected to hear some 600 program participants at 200 sessions discuss the latest methods of saving life and limb by preventing accidents.

In the industrial field alone, 25 complete programs conducted by the industrial sections of the council will cover new developments in safety in such industries as automotive and aircraft manufacture, chemical, construction, food, metals, mining, petroleum, public utilities and wood products.

Original cost rate base repudiated by Iowa court

A Fort Dodge (Iowa) ordinance has been declared unconstitutional by a district court, thus repudiating the original cost rate base theory. The action resulted when a rate increase applicable to the utility's firm customers within the city was denied by Fort Dodge.

The court declared that the fair value method of determining rate base is the only acceptable means of getting at the proper rate. While agreeing that the fair value is not a single figure which is determined by a certain formula, but a judged figure, the court declared "there are areas in the law where justice calls for judgment and opinion," and at times the solution to a problem is not found by merely adding up a column of figures.

Sullivan

Adjusta-flo

GAS CONTROL VALVE

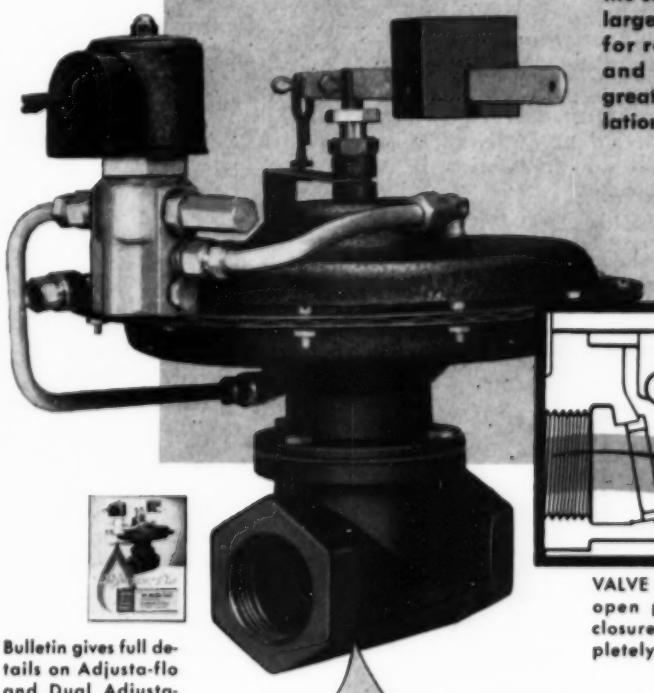
Completely UNOBSTRUCTED GAS FLOW REDUCES VALVE AND INSTALLATION COSTS

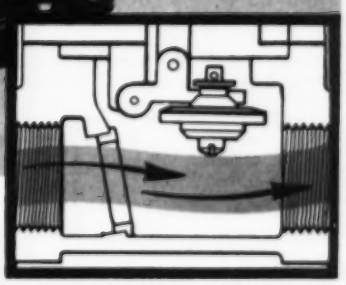
Greater Efficiency for gas boiler installations is provided by Sullivan Adjusta-flo valves. The full-circle valve closure gate swings *completely out of the way* to allow an unobstructed flow of gas up to the full valve capacity. Valve opens manually upon current failure and recycles automatically when current resumes. Adjusta-flo valves are designed to drastically reduce servicing problems.

Completely Adjustable. Gas flow can be easily adjusted for any required amount up to the full capacity of the valve. Valve opening speeds are adjustable up to 60 seconds. Closing time is fixed to insure fast shut-off regardless of opening adjustment. The damper arm is completely adjustable for a full circle swing . . . *move the arm—not the valve.*

More BTUs Per Dollar of Valve Cost

The adjusta-flo gas control valve gives you absolutely unobstructed gas flow up to the full size of the valve. This actually makes its capacity far greater than other valves of the same size rating. Its larger capacity allows for reduced pipe size and valve size and greatly reduces installation costs.





VALVE OPEN . . . in the fully open position the valve closure gate moves completely out of the way.

Bulletin gives full details on Adjusta-flo and Dual Adjusta-flo valves. Write for your copy today.

Manufacturers agents . . . there are a few territories still open. Write for full information.

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Statistical year book for 1955 issued by AGA

The 1955 edition of "Gas Facts," the annual statistical yearbook of the American Gas Association, containing 1954 statistics on the gas utility and pipeline industry, is now available.

Among the new features in the 272-page publication are a separate income statement and balance sheet for pipeline companies alone, from 1941 to 1954; additional statistics on exploratory drilling for natural gas and/or oil; detailed tables showing appliance shipments by size, type of unit, and month of the year. The new edition also includes a table showing, for selected cities, the cost (in cents per million Btu) of various residential heating fuels since 1941, together with suggested fuel efficiency factors.

Extra copies of "Gas Facts" are available from the Bureau of Statistics, AGA headquarters, New York, at $2 per copy for the first five copies and $1.50 per copy for additional copies.

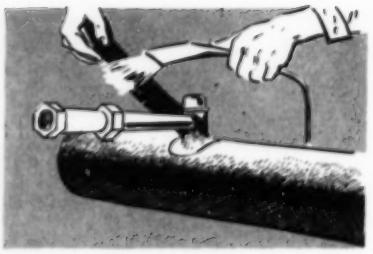
A condensed summary, "The Gas Data Book," has been prepared and now is available for distribution.

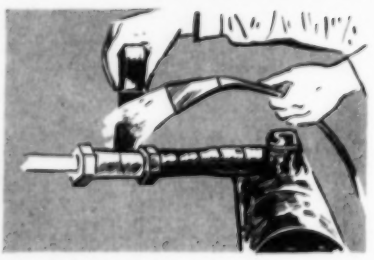
It is a pocket-sized publication, measuring 3½ in. by 6¼ in. and its 22 pages contain historical information on the principal measures of gas industry growth. Costs are 50 cents for the first copy and additional copies at 25 cents each.

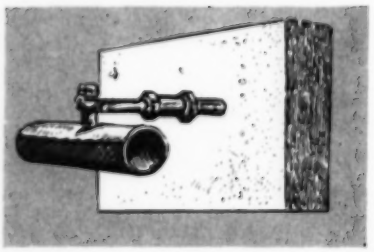
YOU CAN DEPEND ON PROTECTO WRAP FOR COATING GAS SERVICE FITTINGS

PROTECTO WRAP is well suited for wrapping gas service connections and other piping where fittings are used. It consists of a plasticized coal tar or asphalt enamel, of the types used for pipeline coating, saturated into a glass fabric that acts as a carrier and reinforcement for the enamel. The pliability of the bituminous material, when heated, enables it to be molded into conformation with the irregular surfaces. The strength of the glass fabric permits the application of the necessary tension.

The application procedure is the same as used for coating straight field joints. A satisfactory technique for coating the various types of service connections used can be readily developed. Our sales representatives are available to demonstrate this material and method. Address your orders or inquiries to our nearest sales office or to 2255 South Delaware Street, Denver, Colorado.







1406 JEFFERSON AVENUE, HOUSTON, TEXAS
212 PRUDENTIAL BUILDING, PASADENA, CALIFORNIA
1527 EAST 4th PLACE, TULSA, OKLAHOMA
P. O. BOX 33, KENILWORTH, NEW JERSEY
114 EAST ST. CHARLES ROAD, LOMBARD, ILLINOIS
1129 LEWIS STREET, JACKSON, MISSISSIPPI
181 JONES BUILDING, SEATTLE, WASHINGTON

PROTECTO WRAP COMPANY
2225 SOUTH DELAWARE STREET
DENVER, COLORADO

GAS news notes

Houston (Texas) Natural Gas Corp. continued its 48-month financing of gas refrigerators throughout the month of August. Featuring the longest terms on refrigerators ever offered in the area, the HNG appliance purchase plan offers the customer a $500 box for only $13.33 per month, including free insurance against death of the purchaser or destruction of the appliance.

Republic Light Heat & Power Co., Buffalo, was scheduled to receive PSC authority to issue permits for 3000 new gas furnaces by Sept. 15. About 80% of the permits requested since Aug. 15 were for new home heating this winter in Kenmore, Tonawanda, North Tonowanda, and Niagara Falls sections.

L. J. Delaney has established the L. J. Delaney Co. at 541 West Garfield Ave., Glendale, Calif. The company will be a distributor representing Philpott Corp.'s natural gas filters and Security Valve Corp.'s automatic shut-off valves and controls. Mr. Delaney was formerly with the American Meter Co., having spent 10 years as sales engineer working with natural gas utilities.

Acquisition by the Walworth Co. of the assets and business of the Southwest Fabricating & Welding Co. Inc., Houston, is announced. The pipe fabricating company will be operated as a subsidiary of Walworth, retaining present management and employees and continuing present policy.

Absorption Cooling & Heating Corp., Chicago, has been appointed distributor for Servel air conditioning products in the Chicago trading area.

People Gas Light & Coke Co. has installed its one millionth meter in a new all-gas home in Chicago. In recognition of this event, Mr. and Mrs. Edward J. Green, new owners, were presented with four automatic gas appliances: a range and refrigerator by Peoples Gas, a clothes dryer by the Geo. D. Roper Corp and an incinerator by Cribben & Sexton Co. These appliances plus gas space heating and automatic gas water heating make this home an all-gasresidence.

Profit by "Mr. B" local co-op ads!

Tell your customers you are "Mr. B"—the man to see for **BRYANT** quality equipment. Focus the full power of national ads, etc. on your business, your profits!

be "Mr. B"

(AUTHORIZED BRYANT HOME COMFORT DEALER)

Only "Mr. B"—the Bryant Home Comfort Dealer—has *all 8* of these selling assets to build his business BIG:

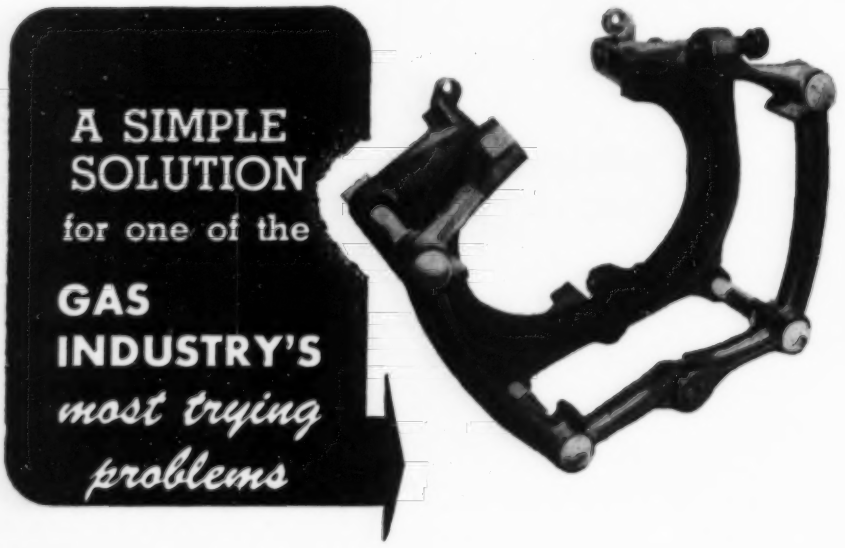
1. A name customers know and want
2. The most complete line of automatic heating, air conditioning, water heating
3. Quality equipment for every market
4. Exceptional distributor service
5. Professional sales training
6. Personalized selling tools for you
7. National advertising featuring you
8. Co-op "Mr. B" ads for local papers

For bigger profits now, for a secure and prosperous future—see your Bryant Distributor. Ask him about Bryant's big "Mr. B" action program, and how it can make sales and money for you!

bryant®

AUTOMATIC HEATING
AIR CONDITIONING
WATER HEATING

THE NORMAC BELL JOINT CLAMP



Solves Your Joint Repair Problems • Quick • Easy • Permanent

Installed in small pavement openings. Available in all standard sizes from 3" to 12". A simple set of tools cleans the joint, installs the clamp . . . often in only a quarter of an hour. SAVES TIME, SAVES MONEY and the repair is permanent. Designed for all conditions particularly where pavement repair costs are prohibitive. Such small opening repairs are scarcely noticeable when pavement is replaced.

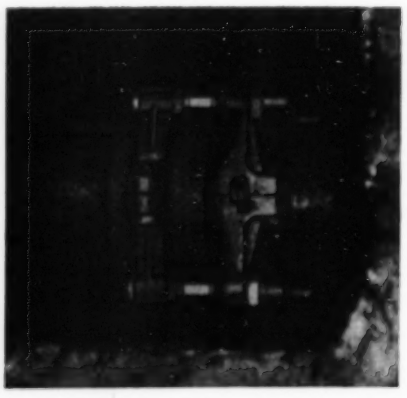
Normac Clamps can be installed in large as well as small openings.

Norton-McMurray hold definite leadership in the development of methods for installation and rehabilitation work through small openings. We welcome the opportunity to help solve a problem you may have—tell us about it.

Write for our catalog describing our complete line of

COUPLINGS . . . FITTINGS . . . SERVICE TEES and ELLS . . . SLEEVES . . . COMPRESSION-END COCKS . . . METER BARS and BRASS FITTINGS for copper pipe.

6 inch Normac Clamp being lowered into hole for installation



6 inch Normac Clamp in service after installation

NORTON-McMURRAY MFG. CO.

122 SOUTH MICHIGAN AVENUE • CHICAGO 3, ILLINOIS

Method and product covered by U. S. Patents, Nos. 2,163,261 and 2,178,286.

news • *Continued*

Northern Illinois Gas Co. plans to furnish approximately 40,000 additional residences in Chicago with gas for space heating. The new authorizations were made possible when the FPC authorized Natural Gas Storage Co. of Illinois to expand its underground storage facilities at Herscher.

Niagara Mohawk Power Corp. has received PSC approval of its plan to substitute natural gas for propane gas in Hudson and adjacent portions of the town of Greenport. PSC approval of the conversion is contingent, however, on FPC approval of delivery of sufficient natural gas to Niagara Mohawk's wholesale supplier, the New York State Natural Gas Co.

B.C. Electric Co. has received PUC permission to distribute natural gas in Vancouver, British Columbia. However, gas service in the area is still contingent upon FPC approval of Pacific Northwest Pipeline Corp.'s plan to extend its pipeline to the international border to connect with Westcoast Transmission Co. lines.

A new office building has just been combleted by Harper-Wyman Co. of Chicago. The new building houses the general office, engineering, and sales departments, as well as an enlarged research laboratory.

Boston (Mass.) Consolidated Gas Co. officially became Boston Gas Co. on Sept. 1, dropping from its company name the word "Consolidated," which described the way in which a number of district gas companies were united 50 years ago to form the present company.

Concise information on meeting facilities of 54 city and resort hotels is contained in the fourth annual edition of the "Digest of Convention Locations," published by Robert F. Warner Inc., 588 Fifth Ave., New York 36.

The price index of natural gas common stocks rose to its third highest peak during the month of July 1955, the AGA reports. On July 22, 1955, the index of prices was only 0.9% lower than the peak occurring April 15 of the current year. At the end of July 1955, the 30 company composite stock price index was 14.8% greater than on the comparable day one year prior, and was 28.7% higher than the lowest price occurring in the 1954-1955 period. Dividend increases of only 5.9% on these stocks, however, resulted in yields declining from 4.81 to 4.44%.

THERMAC

GAS CONTROLS

SR-100 Combination Pressure Regulator and Thermo-Electric Safety Pilot. ⅜" and ½". Capacities up to 90280 B.T.U.

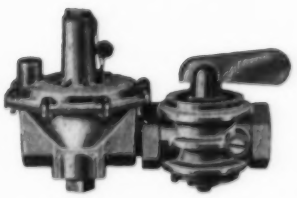
T-11 and T-15 Appliance Regulators. ½" and ¾". Capacities up to 284,000 B.T.U.

SR-200 Combination Pressure Regulator and Thermo-Electric Safety Pilot. ½" and ¾". Capacities up to 226,200 B.T.U.

Model TROD Pilot Regulator.

Aluminum Alloy Manual Main Gas Shut-off Valve. Free flow. ⅜", ½", ¾" and 1".

TR-34D-155, T-50, T-60 and T-70 Regulators. ¾" to 2½". Capacities up to 2,160,000 B.T.U.



Assembly of Thermac Gas Shut-off Valve and Appliance Regulator.

— *finest controls on the market today*

There's no substitute for dependability in a gas control for the proper operation of today's modern automatic appliances. Manufacturers for whom Thermac controls are engineered and built find the following design principles planned into each Thermac product:

1. Higher B.T.U. capacity, per size.
2. More compact. Easy and less expensive to install.
3. Fewer parts readily accessible without breaking line connections.
4. Dependable in performance and rugged to withstand years of hard service.
5. Finest materials and workmanship. Resistant to corrosion. Trouble free.

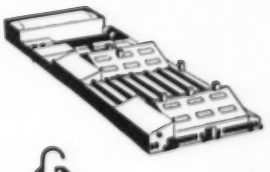
Examine any Thermac product thoroughly. Test it. Compare its performance, ease of adaptability, price and quality. Send for recommendations and samples. See how readily Thermac controls fit into your program.

Call Thermac first for immediate delivery.

THERMAC

HM COMPANY

800 East 108th Street,
Los Angeles 59, California



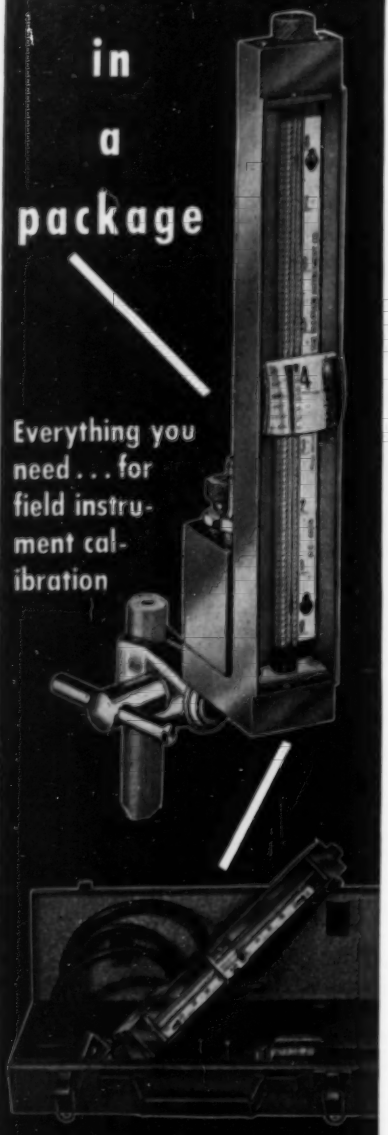
Certified by A.G.A.

"24 years experience building gas controls."

UNMATCHED ACCURACY

in a package

Everything you need . . . for field instrument calibration



MERIAM Manometer Kits

★ Magnifying sight glass
★ Mirror for resolving parallax
★ Built-in level indicator
★ Precision-bore pyrex tubing
★ Built-in fluid seal
★ All stainless steel construction

Write for Bulletin B-2862.

Meriam Manometer Instrumentation ...for pressures, vacuums, flows, liquid levels.

meriam

INSTRUMENT COMPANY
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GAS people

Promotions

S. LLOYD NEMEYER, who has been serving as a consultant on financial and operating matters since 1943, has been elected president and director of Milwaukee (Wis.) Gas Light Co. He succeeds DUDLEY B. W. BROWN, who resigned to become vice president and secretary of American Natural Gas Co.

S. L. Nemeyer
Milwaukee Gas

F. N. Seitz
So. Counties

FRANK N. SEITZ, formerly general sales manager, has been appointed vice president of Southern Counties Gas Co., Los Angeles. He will be in full charge of the company sales programs.

Servel Inc., Evansville, Ind., has established two new appliance sales regions. The Kansas City office will be headed by STANFORD J. GRIMM and the Pittsburgh office will be headed by RAYMOND LUBAR.

HENRY V. BOOTES, vice president of ACF Industries Inc., has been made a member of the operating committee and head of the marketing department of the company.

PHILIP C. KOSCH, formerly sales training director, has been named sales manager for the Bryant division of the Carrier Corp.

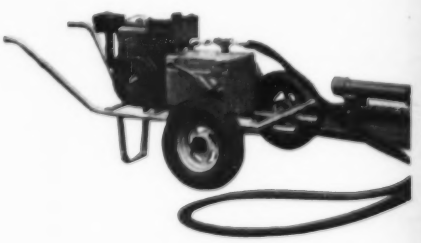
EDWARD E. JOHNSON, meter foreman in the New Britain district of the Connecticut Light & Power Co., has been promoted to safety coordinator with offices in CY&P's general headquarters in Berlin, Conn.

KENNETT W. PATRICK is director of the Transducer division of Consolidated Engineering Corp., Pasadena, Calif. Succeeding him as director of Consolidated's Systems division is HARRY E. BURKE JR.

R. GEORGE CLARR has been promoted to safety director for Ohio Fuel Gas Co., Columbus, succeeding the late R. C. KADEL.

"Pipe installation time and labor costs cut about 50% with Greenlee Pipe Pusher"

That's what a leading eastern utility reports as its experience with a GREENLEE Pipe Pusher on jobs as shown above. Let this remarkable tool make big timesavings and reduce job costs for you, too. With the GREENLEE Pusher, *one* man pushes pipe *under* streets, walks, floors, railways, lawns, etc. Eliminates extensive trenching and time-consuming tearing up, tunneling, backfilling, repaving. Often pays for itself on the first few jobs. Two models: No. 790 for pushing ¾" to 4" pipe; No. 795 for larger pipe and concrete ducts.



POWER PUMP for all models of GREENLEE Pipe Pushers. Makes the toughest pushing jobs simple, fast for *one man*. Average pushing performance: two feet per minute. Write today for complete details on timesaving GREENLEE Hydraulic Pipe Pushers.

GREENLEE

GREENLEE TOOL CO., Division of GREENLEE BROS. & CO.
1950 Columbia Ave., Rockford, Illinois

H. L. Masser

R. I. Snyder
So. Cal.

With the announcement that Executive Vice President H. L. MASSER will retire early in 1956, Southern California Gas Co., Los Angeles, has announced that R. I. SNYDER has become assistant vice president and will act as general assistant to Mr. Masser. GORDON G. DYE, assistant manager of distribution, will assume Mr. Snyder's duties as manager of distribution.

G. G. Dye
So. Cal.

P. S. Harper
Harper-Wyman

PHILIP S. HARPER JR. has been elected executive vice president of Harper-Wyman Co., Chicago. Since 1954 he has been general manager of the company.

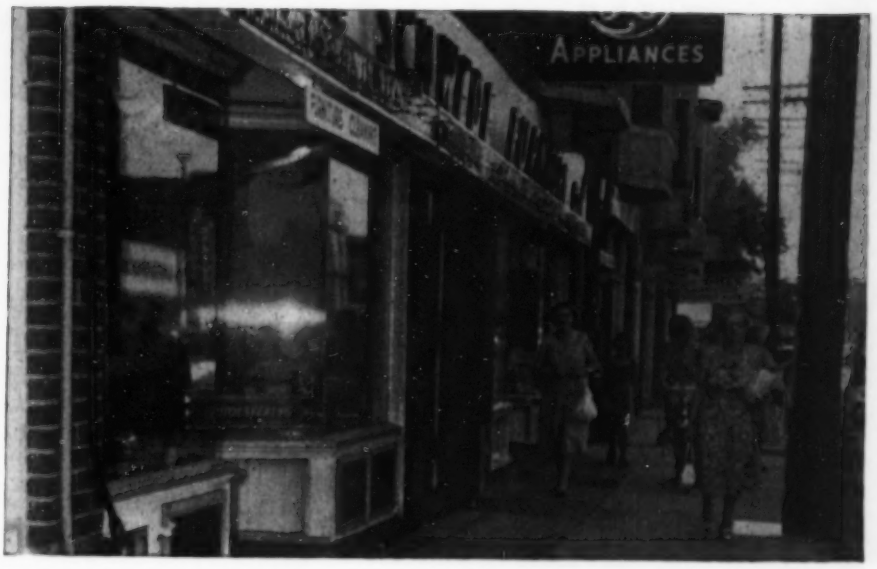
DALE TEEL has been appointed manager of the Tilo (Hawaii Island) division of the Honolulu Gas Co. and of Pacific Refiners, Hawaii branch. He replaces DON MARLETTE, who resigned recently.

PAUL C. KOECHEL has been promoted to the post of supervisor of public relations for Equitable Gas Co., Pittsburgh.

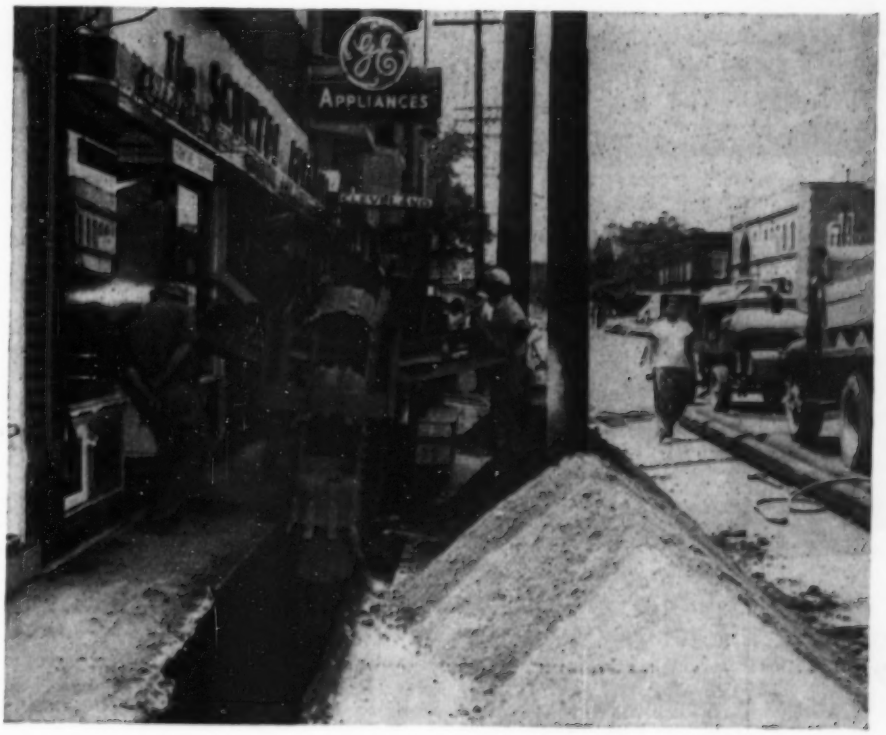
RICHARD H. PETERSON has been named general counsel of Pacific Gas & Electric Co., San Francisco, and FREDERICK T. SEARLS is general attorney.

A. H. AYMOND JR., former attorney for Consumers Power Co., Jackson, Mich., has been appointed general counsel and head of the company's legal department, succeeding WILLIAM R. ROBERTS, who has retired. HAROLD P. GRAVES succeeds Mr. Aymond as general attorney.

CLOSE...



but not *too* CLOSE...



for a "*BABY DIGGER*"

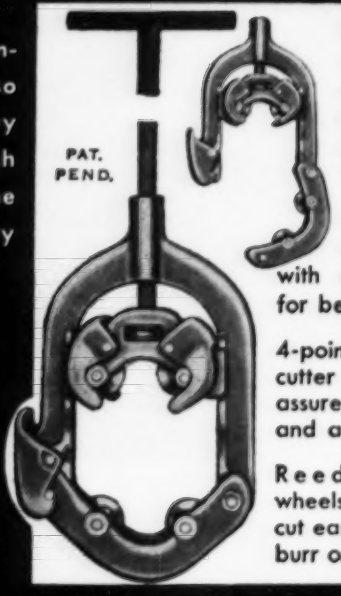
Your local distributor will show you how
Clevelands dig more trench ... in more places ... at less cost.

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave., Cleveland 17, Ohio

CLEVELAND

IF YOU CUT LARGE DIAMETER PIPE...
YOU NEED THESE
New REED HINGED 4-WHEEL PIPE CUTTERS
Four sizes cover the range from 2½" to 12"

Users tell us these completely new cutters are so efficient they often "pay for themselves" through the savings in crew time on a half-dozen cuts. They are the first really practical tools for cutting off steel or cast iron pipe in sizes from 2½" to 12". You can, for example, cut 8" steel pipe completely off in less than five minutes.



Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

Reed Razor Blade wheels track perfectly, cut easily and roll down burr on steel pipe.

Unconditionally guaranteed to be the most efficient cutter you have ever used. Ask your jobber or write for literature.

REED MANUFACTURING COMPANY
ERIE, PENNSYLVANIA • U. S. A.

BORE with HYDRAUGER
(EARTH BORING MACHINE)

Designed for maximum control of the reamer. Earth along the pilot bits acts as a bearing to steady the reamer assuring an accurate hole.

FREE BOOKLET.. SEND COUPON BELOW

HY-250

HYDRAUGER CORP., LTD. 681 MARKET ST. SAN FRANCISCO

Please send, without obligation to me, the HYDRAUGER BOOKLET which shows relative costs and speeds of BORING as well as specifications of various Hydrauger models.

NAME_____ ADDRESS_____

CITY_____ STATE_____

people • *Continued*

L. E. Wallace

R. H. Soape

Orbit Valve Co.

L. E. WALLACE, formerly Houston district manager, has been promoted to the post of sales manager for Orbit Valve Co., Tulsa. He is succeeded by RALPH H. SOAPE, who has been asistant manager at Houston.

R. B. WEIDLEIN has been appointed administrative assistant in the sales department of Koppers Co.'s Tar Products division. Other appointments include: V. J. MARKEY succeeding Mr. Weidlein as training supervisor; C. A. DUNLAP is wage and salary administrator; J. H. FARREN is personnel administrator.

C. ALLAN FEE, secretary since 1950, has been elected vice president and secretary of ACF Industries., New York.

R. S. REYNOLDS JR. has been elected chairman of the board of Robertshaw-Fulton Controls Co., succeeding his father, R. S. REYNOLDS SR., who died July 29. J. LOUIS REYNOLDS and JOHN A. ROBERTSHAW JR. were elected directors at the same time.

New faces

D. R. FULTON is the newly appointed Detroit district manager for Roots-Connersville Blower division.

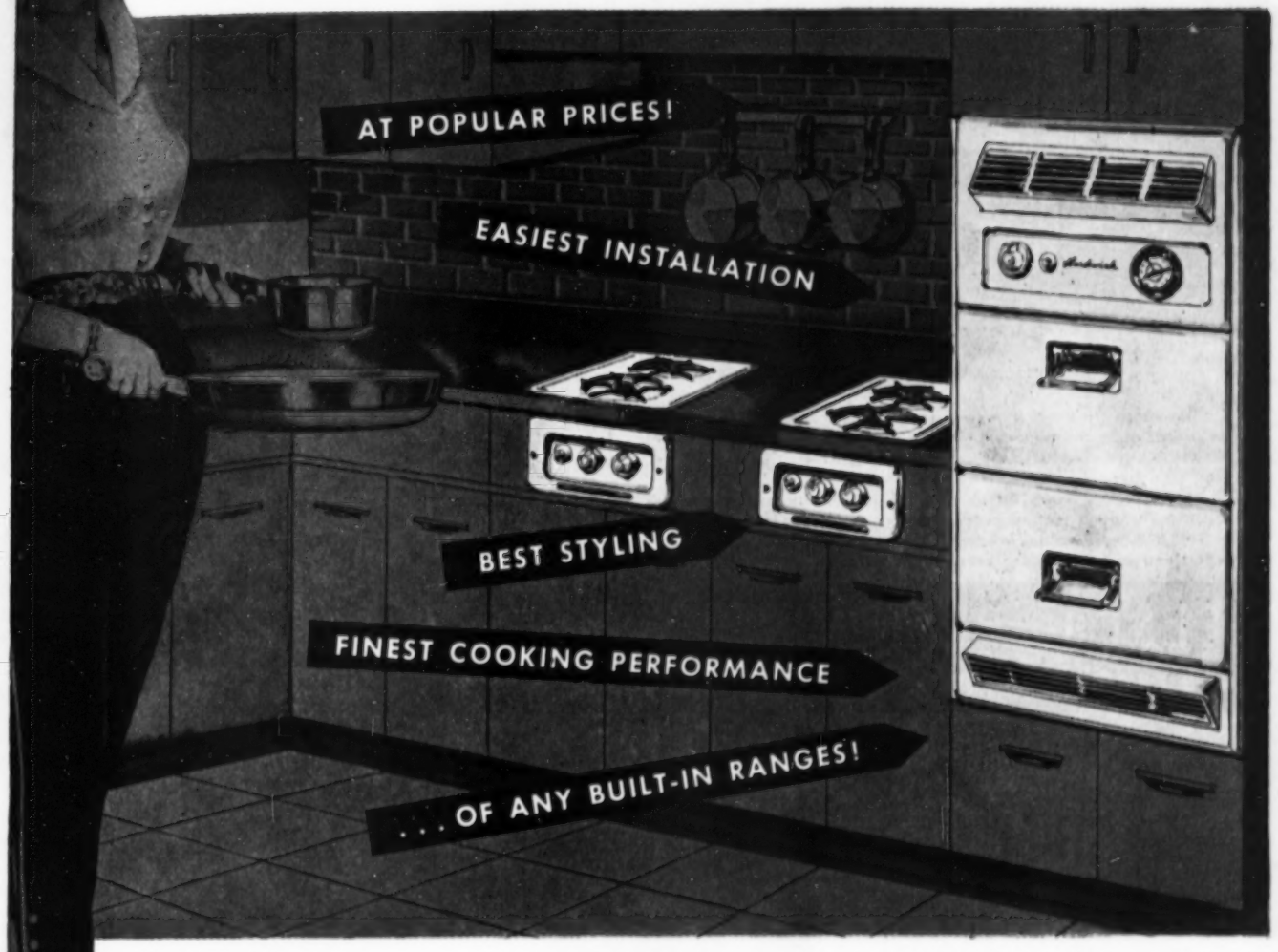
Two new sales engineers for its Heating Appliance Controls division have been announced by Robertshaw-Fulton Controls Co. MILTON G. NICHOLAS will cover Texas, Oklahoma, Arkansas, and Louisiana. JOHN R. GUENTHER will represent the division in the midwest area.

DOUGLAS W. ROGERS has joined the Hartford (Conn.) Gas Co. as residential sales manager.

Among several new arrivals at Servel Inc. are the following men: ROLAND D. PAYNE is sales manager of the home appliance sales division; CURVIN J. TRONE JR. is special assistant to

NEW!

Hardwick high-style built-in gas range units



NOW, at prices any prospect can afford, you can offer glamorous-looking, feature-studded Hardwick built-in ovens and counter-top units—a spectacular addition to any new or remodeled kitchen.

Designed for easy, quick installation, engineered to stay cool, built to maintain the Hardwick reputation as the world's finest-performing range, these built-in units will help you sell and help you keep 'em sold.

See Hardwick Built-In Gas Cooking Units, finished in stainless, coppertone or white porcelain, today!

WHY HARDWICK IS YOUR BEST BUY

★ **INSTALLS IN A JIFFY**—All gas and electric connections in front. Wall installation screws in front. Self-aligning-installation screws clamp the range tight against wall; no fumes can escape to discolor wall.

★ **NO HEAT BLAST IN FACE**—"Cold Air Pump" cools vented air scientifically by blending with room air. Louvers direct air discharge up, away from face.

★ **HEAVY INSULATION BLANKET**—Insulation plus cold-air bath keeps oven walls and surrounding construction cool.

★ **AUTOMATIC LIGHTING**

★ **CLOCK-CONTROL (Optional)**—Oven goes on, cooks, goes off, all automatically controlled when you pre-set clock.

★ **STRIKING APPEARANCE** Styled by America's top range designer.

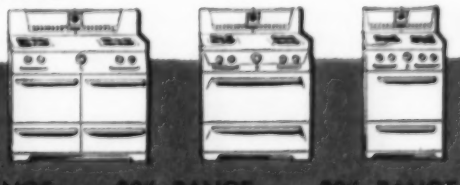
★ **OVEN WINDOW AND LIGHT (Optional)**

★ **ROLL-OUT BROILER**—Hinged door for easy accessibility. Smokeless broiler tray.

★ **HIGH-STYLE BURNER UNITS FIT FLUSH WITH COUNTER TOP**—Automatic-lighting top burner units can be arranged to provide 2, 4, or 6 burners. Easy-installing drop-in units fit flush with counter top and are wedged in with special flat T-moulding.

Gas FOR MODERN HOMES

APPROVED BY A. G. A. FOR NATURAL, MANUFACTURED OR LP GASES



HARDWICK STOVE COMPANY
CLEVELAND, TENNESSEE

Producers of These World-Famous Ranges . . . HARDWICK 36" RANGE . . . 30" RANGE . . . 20" RANGE

Telsco. the tight-sealing
PRESSURE FITTING
that conducts electricity

Telsco Long and Short Couplings, Adapters, 90° Elbows, and Tees, ½ through 2 inches.

Use Telsco Fittings on Plastic Pipe, too—Metal Stiffeners for this application are available.

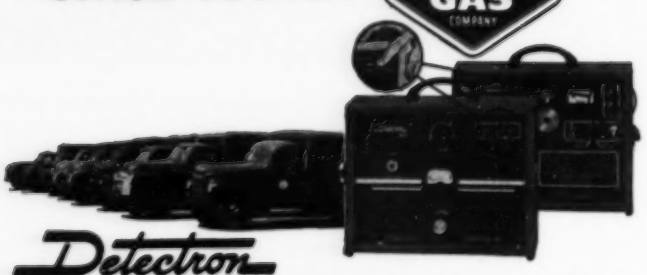
The unique sealing principle used in Telsco Threadless Fittings concentrates great pressure, under containment, on *all sides* of a *small* rubber gasket (See cross section). Under this tremendous pressure, confined in a small area, the gasket forms a tight seal against leaks.

At the factory every Telsco Fitting gets a 90-pound air pressure test, under water—assuring a sound casting every time.

Telsco Fittings do not insulate. Instead they conduct static electricity without the time, effort and cost of bonding every connection.

TELSCO FITTINGS DIVISION
5420 REDFIELD STREET DALLAS 19, TEXAS

SINCE 1951...
SOUTHERN CALIFORNIA GAS COMPANY



Detectron
"505" PIPE DETECTORS -- have been used by Southern Calif. Gas Company

Serving 4,800,000 persons with more than 13,787 miles of main lines.

more than 200 now in use performing ALL these jobs!
•
Detect, trace and center pipes, cables, etc.
•
Estimate their depth
•
Separate parallel pipes, cables, etc.

Maximum efficiency in every operation is the key to the low consumer rates offered by this leading utilties company. Damage or breakage of existing pipeline during street excavation was a costly, time consuming problem — solved by equipping all service and repair trucks with a modern electronic pipe detector.

WRITE FOR COMPLETE "Utilities Instruments" CATALOG

Detectron
COMPUTER-MEASUREMENTS CORP.
Utilities Instrument Divison
5457 Cleon Avenue, Dept. 52, North Hollywood, California

people • *Continued*

the vice president and general manager of the division; and R. J. ARFT has been appointed vice president and assistant to the president to supervise budgets and costs.

VICTOR K. GENGER has joined Florence Stove Co., Chicago, in the newly created position of factory manager of the Kankakee, Ill. plant.

EDMUND F. WAGNER, president of General Realty & Utilities Corp., Scarsdale, N. Y., has been elected a trustee of Consolidated Edison Co. of New York.

HUGH SMITH, secretary of Consumers' Gas Co. of Toronto for the past 13 years, has retired from that position. Mr. Smith, who has been with the company for 33 years, will remain as a consultant.

Transfers

H. VINTON POTTER has rejoined Oklahoma Natural Gas Co., Tulsa, as vice president in charge of sales. Most recently he has been director of promotion and advertising for the AGA. Other ONG appointments include: JOHN C. DEUPREE, sales promotion manager; ROBERT C. KUMLER, advertising manager; JOHN W. SIMMONS, advertising and publication assistant; J. B. ELEY, superintendent of the land and geological department; RAY A. BARRETT, supervisor of rights-of-way and damages department.

H. V. Potter
Oklahoma Natural

J. F. Donnelly
A. O. Smith

JAMES F. DONNELLY, formerly assistant manager of the Permaglas division of the A. O. Smith Corp., has rejoined the company as special assistant to the vice president and general manager. For the last three years Mr. Donnelly has been a vice president of Servel.

Deaths

R. C. WIRTZ, 54, secretary of the Alabama Gas Corp., died recently from a heart attack.

Regulatory trends... Minority charges domination by oil

(Continued from page 12)

well mean, as oil-industry experts themselves have testified before the Federal Power Commission, an increase from the present average wellhead price of 10 cents per thousand cubic feet to an average price of 25 cents.

"2. An increase of 15 cents per thousand cubic feet in the field price of gas, passed along to final customers as inevitably it must be, would add over $800 million a year in the annual cost to consumers of the 5.4 trillion cu ft sold in interstate commerce in 1953. As consumption increases, the added annual cost of such a price increase would be correspondingly increased.

"3. The natural-gas industry is part and parcel of the oil industry. Oil companies dominate it. As consumer costs of natural gas advance, the oil industry will surely reap what it has sowed in this bill by advancing the prices of furnace oil which many household consumers use for heating their homes. Thereafter, prices of natural gas and furnace oil will advance together, neither encroaching upon the province of the other, being blood brothers under the common parental discipline of the giant oil companies which dominate both oil and natural gas. Given the green light of H.R. 6645, both gas and oil prices will rise steadily in each consuming market until they approach the level where exasperated consumers begin to consider scrapping their gas-fired or oil-fired furnaces and returning to the use of coal. In short, the goal of the oil industry in H.R. 6645 is to confront millions of American householders with the decision of scrapping the many billions of dollars they have invested in automatic gas-fired and oil-fired furnaces. Obviously, the oil industry will not drive consumers all the way to this decision. But it can, and will if H.R. 6645 becomes law, make them pay and pay higher and higher prices for gas and for furnace oil up toward, but not quite at the limit of their endurance.

"H.R. 6645, in short, gives congressional approval to the oil industry to proceed to charge all that the traffic will bear.

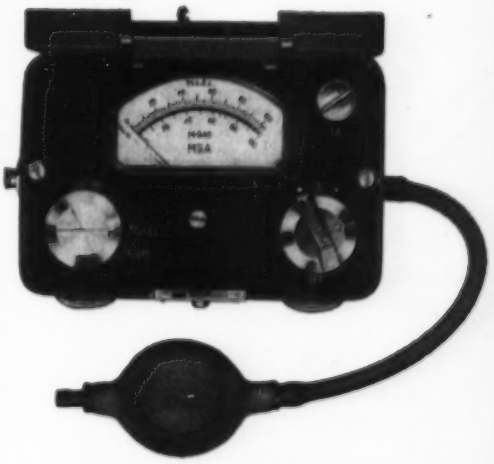
"This is the formula, the hallmark of monopolistic price setting. This is what the majority asks Congress to approve." ■

% L.E.L.
% GAS
This setting gives you 0 to 100% of lower explosive limit
...TURN THE SWITCH
% L.E.L.
% GAS
This setting gives you 0 to 100% by volume of combustible gas

This New Simplicity —New Versatility in ONE instrument ...the M·S·A GASCOPE

The illustration above shows you how, with the simple turn of one selector switch, the M.S.A. Gascope gives you both high sensitivity for the detection of low gas concentrations, and immediate, quantitative response for tracing higher concentrations of gas to its source. Separate scales for each range are calibrated on the fan-shaped meter in the center of the instrument. Each scale is divided by 50 graduations to permit accurate, fast readings.

This dual-range, direct reading instrument is the modern answer to fast, dependable detection and location of gas concentrations over the entire range from 0 to 100% by volume. Write for details, or ask for a demonstration. Your request will be handled promptly.



The Gascope is light, comfortable, and demands no special skill to operate. A variety of accessories are available to meet all sampling conditions.

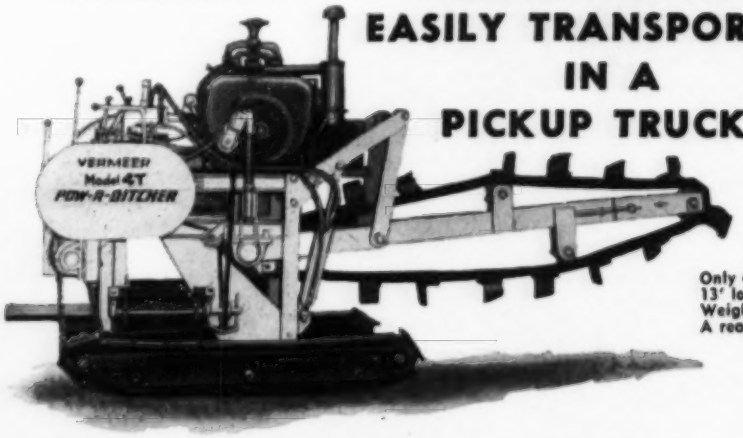
MSA
SAFETY EQUIPMENT HEADQUARTERS

Call the M.S.A. man on your every safety problem... his job is to help you

MINE SAFETY APPLIANCES CO.
201 North Braddock Avenue, Pittsburgh 8, Pa.
At Your Service: 76 Branch Offices in the United States
MINE SAFETY APPLIANCES CO. of CANADA, Ltd.
Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.
Representatives in Principal Cities in Mexico, Central and South America
Cable Address: "MINSAF" Pittsburgh

POWERFUL NEW "MIDGET DITCHER"

EASILY TRANSPORTED IN A PICKUP TRUCK



Only 6' high, 13' long. Weighs 2500 lbs. A real workhorse.

ONLY 42" WIDE

VERMEER MODEL 4T POW-R-DITCHER Digs 6" to 14" Wide and 4½' Deep

Here's the "midget ditcher" they are talking about! The 4T POW-R-DITCHER is designed specifically for laying gas pipe, water and cable lines and digging foundation footings. Its narrow width makes the 4T ideal for those "tight spots." Digs at speeds of 1' to 17' per minute, depending on depth and soil conditions. Powered by a 15 or 25 h.p. Wisconsin engine. The 4T POW-R-DITCHER is built for service and answers the need for a small, rugged inexpensive ditcher. A self propelled and one-man operated machine. Has same size moving parts as larger POW-R-DITCHER models. **Write for name of distributor and complete information. Larger POW-R-DITCHER models also available.**

VERMEER MANUFACTURING CO., PELLA, IOWA

WARRENGAS
A LIQUEFIED PETROLEUM GAS OF HIGHEST QUALITY

WARREN
PETROLEUM CORPORATION
LIQUEFIED PETROLEUM GAS DIVISION
TULSA, OKLAHOMA

SALES OFFICES:
FORT WORTH, TEXAS
HOUSTON, TEXAS
LOUISVILLE, KENTUCKY
MADISON, WISCONSIN
MIDLAND, TEXAS
MOBILE, ALABAMA
ST. LOUIS, MISSOURI
NEW YORK, NEW YORK
OMAHA, NEBRASKA
COLUMBIA, SOUTH CAROLINA

SAFETY by SURVEY
SAVINGS by REPAIR

Hundreds of gas distribution firms have materially improved their safety factor and substantially reduced "un-accounted for" by employing SOUTHERN CROSS FORESTERS to locate and repair their street leakage.

There is a plan to fit your system whether you maintain 5 or 5,000 miles of main.

SOUTHERN CROSS FORESTERS
1429 Peachtree St., N.E.
Atlanta, Ga.

GAS calendar

October

3..Gas Measurement Institute—Legion Hall, Liberal, Kan.

12-14..Wisconsin Utilities Association Electric & Gas Section—Schroeder Hotel, Milwaukee.

12-14..GAMA Annual Meeting—El Mirador Hotel, Palm Springs, Calif.

17-19..1955 AGA and PCGA Convention—Los Angeles.

17-21..National Metal Exposition—Philadelphia.

18..GAMA Industrial Gas Equipment Division — Warwick Hotel, Philadelphia.

24-27..National Association of Railroad & Utilities Commissioners—Asheville, N. C.

25..NEGA Operating Division — Hotel Statler, Boston.

November

13-18..American Society of Mechanical Engineers—Congress & Hilton Hotels, Chicago.

14-17..American Petroleum Institute—San Francisco.

16..NEGA Safety Conference—Hotel Statler, Boston.

16-18..Southeastern Gas Association—Roanoke Hotel, Roanoke, Va.

18..SGA Transmission Management Conference — Shamrock Hotel, Houston.

28-30..SGA Advisory Council & Management Conference — Grand Hotel, Point Clear, Ala.

1956

January

16-18..Pipeline Contractors Association 8th Annual Convention — Boca Raton Hotel & Club, Boca Raton, Fla.

February

15-17..Tulsa Corrosion Short Course for Pipeliners (NACE) — Mayo Hotel, Tulsa.

March

12-16..National Association of Corrosion Engineers Annual Meeting — Hotel Statler, New York.

19-21..MidWest Gas Association — Hotel Fontenelle, Omaha.

22-23..New England Gas Association Annual Meeting — Hotel Statler, Boston.

22-23..Oklahoma Utilities Association Annual Convention — Oklahoma City.

April

4-6..AGA General Management Section Spring Conference — Conrad Hilton Hotel, Chicago.

16-19..AGA Sales Conference on Industrial & Commercial Gas —Hotel Roanoke, Roanoke, Va.

17-19..Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

16-18..National Conference of Electric & Gas Utility Accountants — Hotels Biltmore and Commodore, New York City.

19-20..Indiana Gas Association — French Lick Springs Hotel, French Lick, Ind.

19-21..GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

23-25..Southern Gas Association Annual Convention—Dallas.

23-25..AGA-Midwest Regional Gas Sales Conference — Edgewater Beach Hotel, Chicago.

May

7-10..AGA Distribution, Motor Vehicles, and Corrosion Conference—Congress Hotel, Chicago.

7-11..AGA Commercial Gas School — Edgewater Beach Hotel, Chicago.

10-11..AGA Gas Supply, Transmission & Storage Conference—Conrad Hilton Hotel, Chicago.

16-18..AGA Chemical Engineering & Manufactured Gas Production Conference — Philadelphia.

22-24..Pennsylvania Gas Association —Pocono Manor Inn, Pocono Manor, Pa.

STOPS

HAYS ✓ ✓ ✓

-Service Line
-Meter
-Appliances

STOPS
Tamper Proof
and
Standard Patterns

STOPS
Iron Body with Brass Plug
Black or Galvanized
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ERIE, PA.

Gas Digest

A digest of what's new in products and trade literature compiled by the editors of GAS as a reader service.

New Products and Trade Literature

For more data on any of these items use the coupon on the bottom of next page!

1. Lubricating Gun

A new, compact, self-priming lightweight air-operated lubricating gun designed to meet field and plant maintenance needs, has been introduced by Rockwell Manufacturing Co.

The new "Hypregun" weighs only 39 lb and operates on air pressures up to 150 psi. It is recommended especially for large-scale valve lubricating in refineries, compressor stations, gasoline plants, cycling plants, pipelines and Christmas tree installations.

A specially designed air motor and double piston construction provide the self-priming action.

The Hypregun uses Rockwell-Nordstrom 5-qt lubricant cans which are loaded directly into the gun, eliminating all manual handling of lubricant or changing lubricant from one container to another.

Rockwell Manufacturing Co.

■

2. Gas Control Valve

The new Adjusta-Flo gas control valve for the control of gas burners has been introduced by Sullivan Valve & Engineering Co. The new valve features unobstructed gas flow for increased capacity.

A full-circle valve closure gate swings completely out of the way to allow an unobstructed flow of gas up to the full valve capacity, making its capacity far greater than the valve size rating, according to the manufacturer. The gas flow can be easily adjusted for any required flow up to the full capacity of the valve.

The damper arm is completely adjustable for a full circle swing. In addition, valve opening speeds are adjustable up to 60 seconds, while closing time is fixed to insure fast shut-off. Special design makes the Adjusta-Flo extremely easy to service.

Sullivan Valve & Engineering Co.

■

3. Dewpoint Indicator

A new, portable, manually operated dewpoint indicator for easy, convenient measurement of moisture in gases has been announced by General Electric's instrument department.

Designed for applications where only periodic checks of dewpoint are desired, the indicator determines the moisture content of a gas by measuring the temperature at which the moisture begins to condense. This is done by cooling a mirror surface and observing the temperature at which dew first forms. The dewpoint temperature directly describes the water vapor content of a gas.

Especially useful for monitoring the moisture content of furnace atmospheres in the heat treatment of metals, the dewpoint indicator is also designed for use by manufacturers of gases, and by large users of gases.

The indicator gives accurate readings over the range of dewpoint temperatures from ambient to -100° F (0.003% moisture by volume in air). It requires no electrical outlet, operating on a self-contained battery, and can be used to measure different gases in rapid succession. Weight is 16 lb.

General Electric Co.

■

4. Bleeder Plug

Thornhill-Craver Co. has announced a new feature for Unibolt products, "Plug-Lok." The new feature, as illustrated in the accompanying Christmas tree cap, provides a convenient bleeder plug, which does not interfere with or prevent the use of a pressure gauge. It is optional on all Unibolt products.

Thornhill-Craver Co.

■

5. Fiberglas Coupling

Reinhold Engineering & Plastics Co. introduced a new development in electrolytic control—a fiberglas reinforced

coupling, the "Electro-Stop," used where two dissimilar metals, finishes, or soils cause corrosion because of electrolytic action.

These couplings have a high burst and tensile strength. They will withstand pressures of 200 psi with a safety margin of more than 5 to 1.

Because of the "filament wound" process of manufacture, the threads are an integral part of the structure and offer exceptional strength and resistance to breakage and wear. Their coefficient of expansion is essentially the same as most commonly used metal piping, so that no seepage will occur because of temperature change.

A positive mechanical break to galvanic action is provided by "Electro-Stops" by means of a dike which also prevents bridging by sediment.

They will resist temperatures up to 160° F with an ample safety margin. Their durable construction will allow pipe wrench installation.

The coupling is available in standard pipe sizes of ½ in. to 4 in.

Reinhold Engineering & Plastics Co.

■

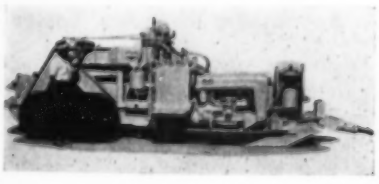
6. Automatic Incinerator

Given Manufacturing Co. is engaged in full-scale production of the Waste King automatic gas incinerator, which, according to company reports, disposes of all burnable refuse and rubbish by a specially developed dehydration principle that eliminates smoke and noxious odors and prevents open fire burning.

The Waste King is completely automatic; a Flame-Monitor maintains a safe constant temperature for continuous operation. Complete fibre-glass insulation is used. Although it occupies less than 3 sq ft, the new Waste King incinerator can dispose of 2 bushels of refuse in one loading.

Given Manufacturing Co.

■



7. Vertical Pipe Bender

Of particular interest to pipeline contractors who specialize in laying large diameter lines is the first vertical pipe bending machine to utilize hydraulic action for making cold, smooth bends manufactured by Cinch Pipeline Equipment Inc. This machine has been field proved recently on a 36-in. transmission line being laid in Georgia and North Carolina. One contractor reported that 122 bends were made on the 36-in. pipe in one 10-hour day. Some bends were as much as 21° in a 40- ft joint of pipe with wall thickness of .406 and .469.

Its dimensions are such that it can be quickly and easily transported on a float trailer without removal of tracks. This new vertical hydraulic pipe-bending machine is available in two sizes: 16 in. through 30 in. or 22 in. through 36 in.

Cinch Pipeline Equipment Inc.

■

8. Vacuum Cleaner

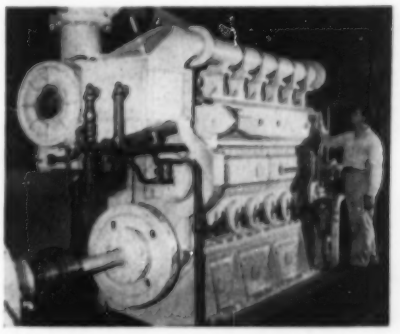
Designed to operate in hazardous locations restricted to ordinary industrial vacuum cleaners, the Doyle explosion-proof vacuum provides complete safety for wet or dry recovery of explosive or inflammable dust and gases. This portable, lightweight unit has Underwriters Laboratories approval for use under hazardous or explosive conditions: Class 1, Group D, and Class 2, Group G.

The casters, bag, hose, attachments and connecting gaskets are electrically conductive so static charges are grounded. Motor, switch and cable connections are totally enclosed; every part is explosion proof. In addition, all exposed surfaces are non-ferrous brass and aluminum construction to eliminate sparks and prevent rust and corrosion encountered in most liquid or chemical recovery.

The Doyle explosion-proof vacuum cleaner is powered by a full ⅞ hp motor, scientifically teamed with a multi-stage fan assembly for high suction. The solid brass vacuum tank has an 8-gal. capacity and features an internally mounted static proof dust filter. Four extended swivel casters prevent tipping and provide easy portability over any type of floor surface.

Doyle Vacuum Cleaner Co.

■



9. Moderate Speed Engines

A completely new design in moderate speed, 4-cycle, heavy-duty diesel, dual-fuel, and gas engines with ratings up to 1400 hp has been announced by Worthington Corp. The new medium speed engines are designed for service in utility and water works, sewage disposal plants, irrigation, chemical and petroleum, marine drives, mining, radio and radar stations, pump or blower drive, and mobile power applications.

Most modern and unique feature of the company's new W 9 line is "Jet-Swirl" turbocharged power, a streamlined design for air inlet which brings the air in parallel to the inlet valve stem and gives it a swirl as it enters the cylinder.

The entire engine is structurally designed for operation at 200 psi, bmep.

GAS **Reader Service**

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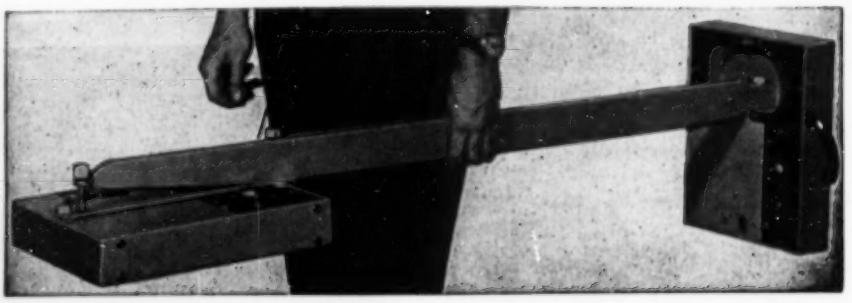
THE WILKINSON LINE LOCATOR

A precision instrument for detecting the position and depth of any sub-surface pipe, cable, stub, valve, coupling, etc.



The dependability of the Wilkinson Line Locator is amply attested by its wide use. Leading gas, oil and pipe line companies generally KNOW its value.

WILKINSON PRODUCTS COMPANY

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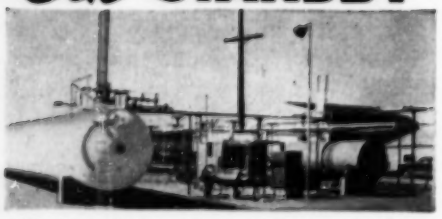
GAS STANDBY



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Servicing Gas Industries For Over 40 Years

GAS Digest • Cont'd.

The new line operates on lowest cost fuels—residual, crude, and distillate oils, natural, sewage, propane or manufactured gas.

Worthington Corp.

■

10 Floor Furnaces

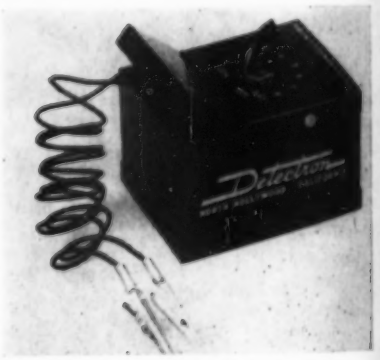
A new line of floor furnaces has just been announced by the D. P. Ran Appliance Corp.

Both inner and outer casings are of 24 gauge galvanized steel. Extra heating elements are hand-welded. All units are factory-tested and all elements are guaranteed for 10 years against rusting or burning out. All models are built with a safety lock plate that prevents turning on the furnace when the pilot is not on.

These floor furnaces are available in four sizes in both the flat furnace and the dual floor-wall furnace (pictured).

D. P. Ran Appliance Corp.

■



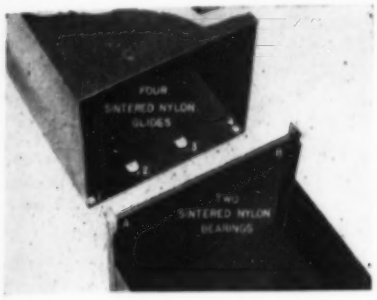
11. Automatic Shut-off Tester

Appliance servicemen can now quickly test B-60 and other thermomagnetic devices including thermocouples and thermopiles without guess work and without shutting down the appliance, according to the manufacturer of the new Detectron T-8 automatic shut-off tester, the Utilities Instruments Division of Computer-Measurements Corp.

The T-8 ASO tester will immediately locate trouble in thermomagnetic and other valves because it operates as a continuity tester. The continuity test permits the tracing of wiring in ranges, dryers, switches, and automatic defrost and ice-maker circuits, as well as switches that open and close. In addition, it has eight switch positions representing various current valves ranging from 13 milliamp to 565 milliamp. Rather than rely on just the high and low positions, the added six positions have been incorporated in order to distribute, more accurately, the current requirement for each device. Switch positions for the more common valves are printed on the inside of the tester case —or are available on request.

Utilities Instruments Div.

■



12. Steel Files

Safe-T-Stak steel files equipped with sintered nylon bearing are available from Diebold Inc.

The new Diebold nylon-glide files operate with smooth bind-free "gliding" action. Sintered with graphite filler, the nylon bearings never require lubrication.

Diebold nylon-glide files can be expanded either vertically or horizontally by adding standard 1- and 2-drawer units as needed. Safe-T-Stak cases interlock vertically, side-to-side and back-to-back to form rigid batteries of files. Vertical locking keys and horizontal tie-links are inserted easily into the prepared domes on each case. No tools are needed. Cases are fabricated from reinforced heavy gauge steel to support weight of loaded files and to prevent drawer "binding" even when they are stacked ceiling high.

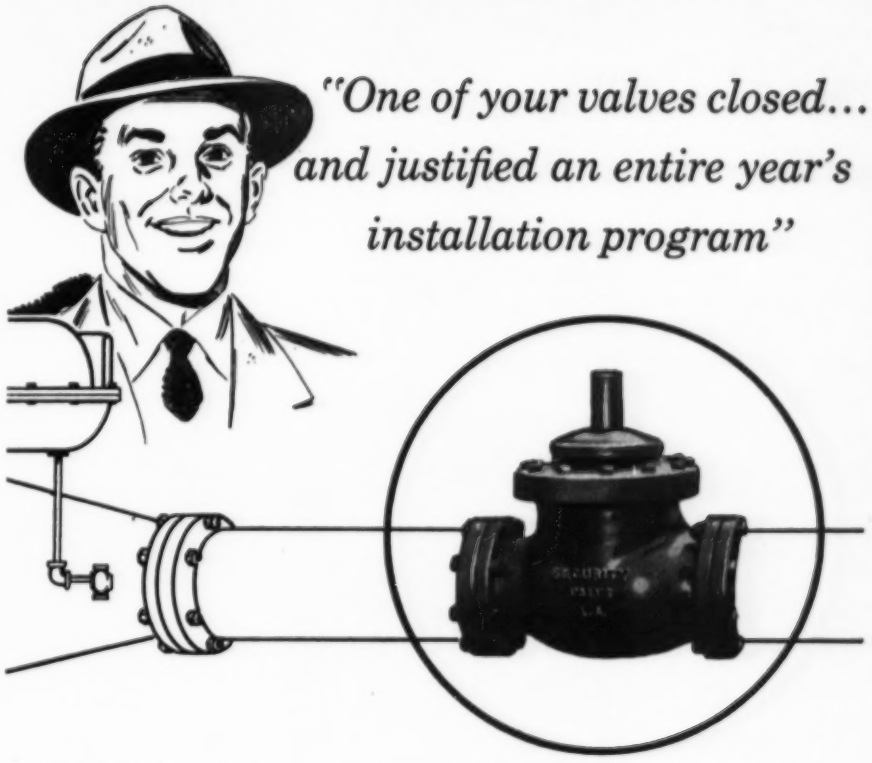
Diebold Inc.

■

13. Threading Machine

Toledo Pipe Threading Machine Co. has added to its line of pipe tools and machines the Toledo No. 78 Vermette power drive, which can be used for all cutting, reaming, threading, and fitting operations.

The new unit features heavy-duty



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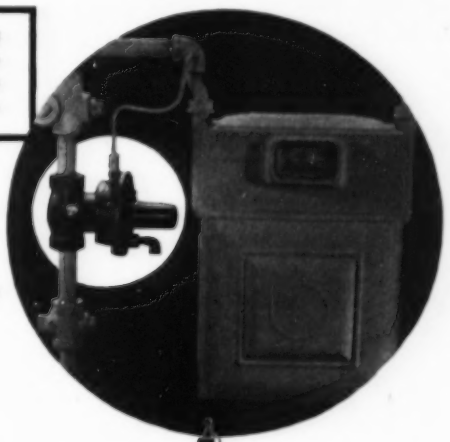
Security Valves are positive and always dependable . . . they are engineered for one specific function. Vital in congested areas, they eliminate both the expense and hazard created by high-capacity vent lines necessary when other over-pressure protection devices are employed.

A *complete* line, Security Automatic Shut-Off Valves are available in sizes ¾" to 12" for use on lines operating on inches water column to 1500 psig. They can be installed up or downstream of the regulator and controlled directly or by means of a pilot line.

Security Automatic Shut-Off Valves range from ¾" for domestic lines (right) to large distribution line sizes (above).



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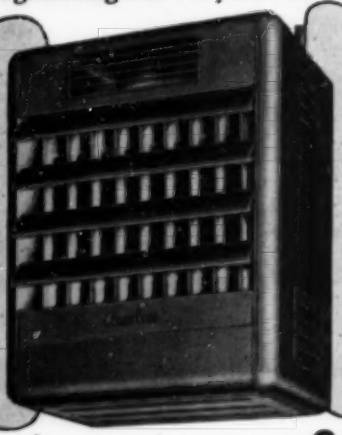

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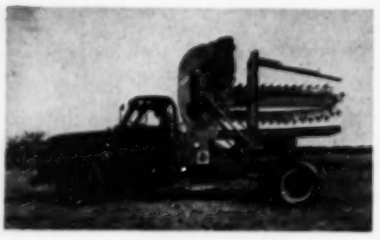

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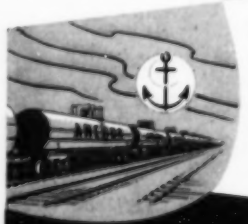

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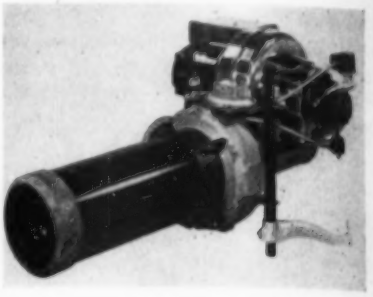
construction combined with compactness and light weight. The chuck takes only a few seconds to set up. It handles ¼- to 2-in. pipe and conduit. The chuck grips, tightens, and centers pipe automatically in forward or reverse.

Toledo Pipe Threading Machine Co.

14. Dual Fuel Burner



The new Webster Cyclonetic dual fuel burner is available in three sizes over a range of from 15 to 92 hp with low pressure gas and light fuel oil. Produced by the Webster Engineering Co. as an assembled, pre-wired and tested package, the burner features a stainless steel combustion head to retain the gas flame firmly on the outer periphery of a turbulator to assure smooth, quiet operation and to prevent overheating and cooking of the oil nozzles while burning gas.

The standard units include a complete programming electronic combustion safeguard system with both pre-purge and post-purge by the forced draft blower. Special circuitry is available to satisfy any local code or other approval requirement.

Webster Engineering Co.

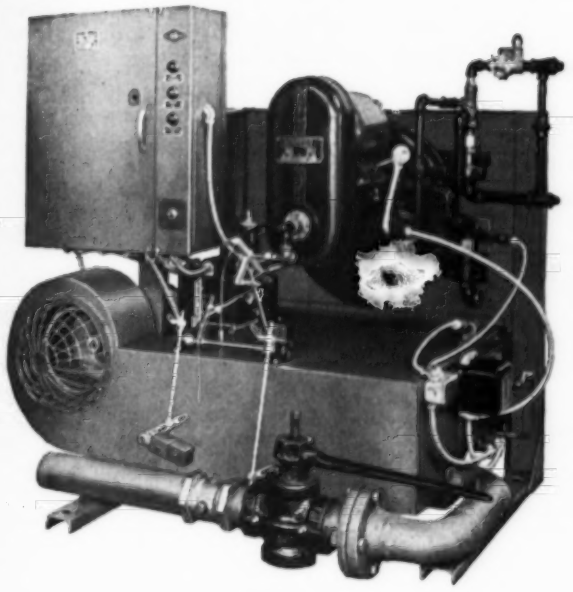
■

15. Chain Wrenches

A completely new design in chain wrenches for plumbers, pipefitters, and maintenance men has been announced by Reed Manufacturing Co.

The chain-and-jaw grip permits working in tight corners, between parallel pipelines, close to baseboards, or wherever there is too little clearance for the head of a conventional wrench. It is also possible to tighten and back off a pipe or fitting without taking the wrench from the pipe or changing the setting.

WEBSTER* ROTONETIC



DUAL FUEL FIRING BURNER

- V Sizes from 75 to 300 horsepower.
- V Minimum gas pressure requirements.
- V Low installation costs.
- V Maximum efficiencies on BOTH gas and oil.
- V Minimum base height requirements.
- V Utilizes all grades of fuel oil.
- V Extremely low noise level.
- V Approved electronic combustion safeguard system.
- V Simpler changeover than ever before.
- V One hundred per cent forced draft.
- V Completely assembled, piped, wired and tested.

These and many other outstanding features combine to provide the same dependable high quality performance as the WEBSTER DYNETIC gas burner. Neither fuel must suffer if the WEBSTER ROTONETIC is used. With integral pumps, integral oil preheaters for heavy oils, patented oil burner "flame-shaping" vanes, and full modulating or optional high-low control, the WEBSTER ROTONETIC is designed to provide long lasting customer satisfaction the year around.

It is furnished with a precast refractory front as an integral part of the burner assembly. The installer need only finish the furnace wall on each side and above the burner. 44-7

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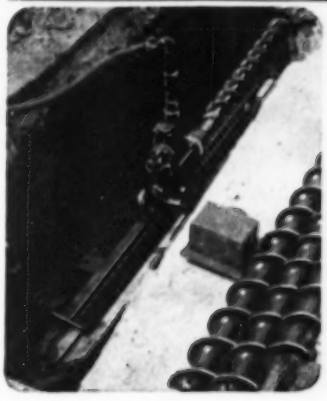

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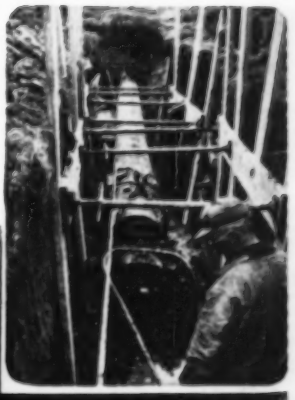

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EARTH BORING EQUIPMENT
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The wrench is currently offered in 10-, 14-, 18-, 24-, and 36-in. lengths.
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Two Way Protection...

When Gas Boosters Are Used

- **Eliminates Suction Hazards**
- **Stops Back Pressure**

The lower valve prevents suction from going beyond valve.
The upper valve prevents any back pressure from entering gas line.
Both valves are soft seated for positive shut off.
Sizes from ½" to 6".

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Hard To Locate
Gas Pipes
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TRADE LITERATURE

16. Protective Coating Brochure

How to get greater coverage from protective coating at lower costs in safeguarding pipe, pipe joints, fittings, and couplings is described in a new brochure from Tapecoat Co. The brochure covers the complete story of Tapecoat-X, a new coal tar coating in tape form. Included in the booklet is a table of coverage showing how the new product goes farther and reduces costs.
Tapecoat Co.

■

17. Digital Computer Booklet

The ALWAC III, a high-speed fully automatic electronic digital computer manufactured by Logistics Research Inc., is described in a four-page, two-color illustrated brochure. The new brochure contains a table of specifications.
Logistics Research Inc.

■

18. Valve Regulator Bulletin

"Special Controls" is the title of Bulletin 1094 published by Rockwell Manufacturing Co. describing its line of high and low pressure balanced valve regulators. Consideration of specific regulator problems and solutions are presented by use of full pages of text together with a facing page of cross-sectional schematic drawings of each of 16 distinct gas regulation situations in which "special" controls are called for.
Rockwell Manufacturing Co.

■

19. Hydraulic Jacks Catalog

A two-page descriptive bulletin has just been published on self-stowing hydraulic support jacks, manufactured by J. H. Holan Corporation. The bulletin gives dimensional information and performance data and describes by diagram how the exclusive Holan Self-Stowing feature operates.
J. H. Holan Corp.

■

20. Compressor Bulletin

A new 16-page bulletin from Le Roi division of Westinghouse Air Brake Co. describes and illustrates component parts and the complete packaged unit of Le Roi gas booster compressors, which consist of a gas-gathering compressor powered through a clutch and V-belt drive by a Le Roi engine. Detailed descriptions are presented.
Le Roi Division

■

21. Heater Catalog

Prat-Daniel Corp., Thermobloc division, has announced publication of a new general catalog (GC-4-55). In addition to a full color cut-away illustration of a Thermobloc heater, the two-color catalog features photographic reproductions of five Thermobloc models as well as dimension drawings on floor set and suspended models and halftone reproductions of Thermoblocs.
Prat-Daniel Corp.

■

22. Detector Data

Model 4 electronic Vibraswitch is used to detect malfunctioning of pipeline compressor engines, other gas engines, centrifugal compressors, cooling tower fans, and turbines through detection of minute vibrations before the trouble would be apparent for detection by temperature rise or increased load. Technical data and other information are now available for the Model 4 Vibraswitch.
The Beta Corp.

■

23. Metal Tag Catalog

A new catalog has been issued by the Dickey-Grabler Co. on its metal tags, checks, and plates for numbering and marking all types of properties used by public utilities. If it needs to be numbered, tagged, or badged, there is the answer on one of the pages of this new catalog.
The Dickey-Grabler Co.

■

24. Coating Bulletin

Technical data are now available for Plicoflex No. 330, a single-film, Polyvinyl chloride tape coating, and Plicoflex No. 340, a laminated polyvinyl chloride and butyl rubber tape coating, both for pipeline use. Engineering data, price lists, samples, and ordering information are now available.
Plicoflex Inc.

GAS staff report

"The Scenic Inch"

Record-breaking construction schedule bringing San Juan gas to Northwest

By J. FRED EBDON • Managing Editor

WITH the coming of spring "construction weather" this year, the culmination of five years of planning, designing, and, at times, dreaming was realized when contractors' spreads started physical construction on the 1466-mile natural gas pipeline that will serve one of the last remaining sections of the United States that still lacks natural gas. The pipeline was at last on its way from the arid, but potentially very productive, San Juan basin in New Mexico and Colorado to a point brushing the Canadian border at Bellingham, Wash. It is disarmingly easy to say that the pipeline will extend from the San Juan basin to Bellingham—the fulfillment of this objective will not be so easy.

As presently certificated by the Federal Power Commission, the mainline will vary from 26 to 6 in. in diameter and will originate at Ignacio, Colo.

An application is now pending before the FPC which would authorize supplemental gas from Canada and, if approved, would change the mainline pipe sizes to include 26-in. from the Canadian border to Umatilla, Ore.; 22-in. from Umatilla to Green River, Wyo.; and 26-in. from Green River to the origin of the line, Ignacio, Colo., and increase the system capacity by approximately 300 MMcf per day.

From Ignacio, it vectors northwesterly through the ancient and once sacred lands of the Ute and Mesa Verde Indians, virtually within the shadows of Shiprock, N. M., where the startling Shiprock bares its rugged crags to further ravages of time's erosion. In the next 235 miles the line passes into Utah, back into Colorado, and again into Utah. All of this right-of-way is in country that tourists class as some of the most scenic in the United States. For example, near Moab, Utah, rock in its most tortured form must be traversed; then, as the line winds its way back into Colorado, a passage is made over Colorado's Douglas pass (elevation - 8000 ft). Thence, the right-of-way goes into Utah again where it passes through Dagget mountain range, with Mt. Lena at 9722 ft, and generally north into Wyoming.

Near Rock Springs, Wyo., a connection will be made with a pipeline now under construction by Colorado Interstate Gas Co. that will take gas at this point for delivery to north-central Colorado markets. As the mainline leaves Fort Bridger, Wyo., and until it reaches Fort Walla Walla, near the Columbia river, it follows the exact trail over which our pioneering generations drove, and at times manually hauled, their Conestoga wagons—the historic "Old Oregon Trail." This pathway to the Pacific Northwest now serves again its purpose of providing a natural highway for the natural gas pipeline that has adopted the name of the area it will serve—the Pacific Northwest Pipeline. So, the Old Oregon Trail brings a new era of prosperity into the territory of Paul Bunyan. It is a pipeline that surveyors and men on the spreads have cussed because the country through which it passes has been termed by them as other than scenic—some feel it is indeed a typical job for our legendary friend, prodigious Paul Bunyan.

The Pacific Northwest pipeline crosses, and branches at the Columbia river. The mainline follows the Columbia river valley westward to Portland, Ore. while one lateral slices north through the Yakima valley to Ellensburg and on to Wenatchee, Wash. and another lateral takes off northeasterly to Spokane, Wash. The mainline travels on from Portland to Bellingham, via Tacoma and Seattle. A connection will be made near Bellingham with a Cana-

OCTOBER, 1955

NORTHWEST GAS

Map of the Pacific Northwest pipeline.

dian pipeline to be built for Westcoast Transmission Co. Ltd., if present applications before the FPC are approved.

Problems? Yes, but although the going is tough in places, the Pacific Northwest pipeline is being built by Fish Northwest Constructors Inc.—people who know pipelining and are not dismayed when the country is rough. They are getting the line "in the ground" fast. This steel conduit will be doing its designed task efficiently and safely, on time.

How It Started

The Pacific Northwest area is one that has been helped or hampered, depending on how you look at it, by the influx of government projects that have attempted to apply taxpayers' money to the end of supplying cheap fuel or power with which the industrial expansion of that land was to be developed. One should judge for himself the success or failure of this ambitious program. There is one salient fact that stands out to those in private industry concerned with supplying energy—there is no cheap fuel in the Pacific Northwest, or, at best, there is not enough available to further and fully exploit the expected potential.

In June 1949, Ray Fish, president and director of the Fish Engineering Corp., reached a conclusion that private enterprise might do the job of bringing an economical fuel into the Pacific Northwest. In this spirit, Mr. Fish and able, young R. R. Herring made an on-the-ground market-potential survey of that area. Tied in with this was, of course, a study of the factors to be considered for supplying natural gas to any market they established and the possible sources of gas to supply the estimated needs. The trip included visits to the various utility companies operating there, a look at the electric and fuel oil operations, and took them to the province of Alberta, Canada, which at that time was considering to export Canadian gas to the Pacific Northwest.

This preliminary survey convinced them that there was an ample market that could be developed for natural gas in this "virgin" territory, and that it could be delivered economically and at a profit that would justify a private

Through the flat wheat fields . . .

corporation's investment for the many facilities required for such an objective. Accordingly, Mr. Fish immediately formed the Pacific Northwest Pipeline Corp., and invited 12 associations to invest funds with him to cover the promotional phase of the project. Subsequently, an application was filed with the Federal Power Commission in Washington, D. C. which contemplated the use of United States' natural gas reserves as the primary source of supply, with gas from southern Alberta fields as a supplementary source. The long road which has lasted for five years was then underway.

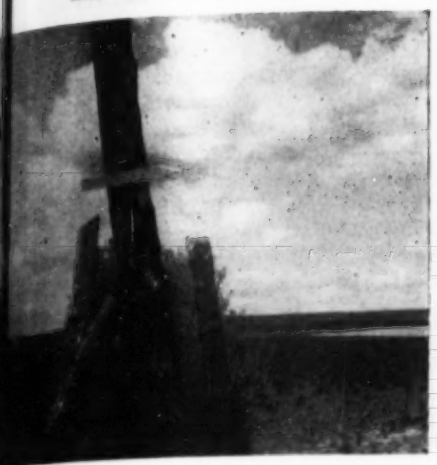
Promotional Phase

The Pacific Northwest Pipeline Corp. was not the only company that saw the future in supplying some part of this new market area with natural gas. Westcoast Transmission Co. Ltd. at this time proposed a pipeline to bring northern Alberta Peace river gas through the Canadian Rockies to Vancouver, B. C. and Portland, Ore. markets, and to markets between. An amendment to this company's application included service to inland Washington to the Spokane area through Trans-Northwest Gas Inc.

Northwest Natural Gas Co. had a proposal to bring gas from southern Alberta to serve the primary markets of Washington and Oregon. Still another company, Glacier Gas Co., formed by Montana Power Co., proposed to extend its system from Montana into the Spokane area.

Westcoast, Trans-Northwest, North-

into the rolling prairie . . .



up the foothills . . .

and over the mountains . . .

. . . the Pacific Northwest pipeline batters its way from the San Juan basin toward its ultimate goal virtually on the Canadian border.

west, and Glacier were vying for the approval of the Alberta authorities, as well as the Federal authorities in Canada, for certification of their proposals to afford each one a source of gas, while Pacific Northwest was negotiating for gas purchase contracts in the southwestern part of the United States. This problem of gas acquisition, including the formation of a definite policy on gas export in Canada, went through a long period of protracted involved negotiations and hearings before a definite pattern began to take shape.

The Alberta authorities, by June 1952, had worked out an approval of the application of Westcoast Transmission Co. for the exportation of northern British Columbia and Alberta gas to the Pacific Northwest; however, they reserved central and southern Alberta gas for transmission to eastern Canada. Several of the operating gas utilities in the Pacific Northwest considered this policy capricious and proceeded to execute contracts with Pacific Northwest Pipeline Corp. for complete gas supply from the United States' reserves. Accordingly, hearings before the FPC were called for February 1953 with two definite projects, each with the necessary gas requirements, vying for the right to transport natural gas into the Pacific Northwest area.

Westcoast Transmission Co.

This company proposed to gather gas over a 280-square mile area in the Peace river section of northern British Columbia and Alberta. This gas was isolated from any immediate market prospect and Westcoast was successful in securing contract for an initial rate of $0.05 per Mcf. The natural gas market, initially between Vancouver, British Columbia, and Portland, was relatively small. Manufactured gas utilities in this market area were (and are) under-developed and had experienced considerable trouble in their operations under competition from subsidized electric power and the inroads of fuel oil as a prime fuel. The ideal solution in the design of Westcoast's proposed transmission system would have been to construct a large diameter pipeline through which the movement of large gas volumes would have had a relatively low unit cost; however, the firm utility market they were able to line up did not provide this volume. Nonetheless, the engineering firm that had been retained by this company designed a pipeline capable of transporting 350 MMcf per day. Then, in order to establish sufficient earnings for the financing of the project, Westcoast, in its exhibits before the FPC, showed the sale of large volumes of gas to industrial customers on an interruptible basis at just a little below the prevailing residual oil rates. Even with this, the forecast for the company did not show a full 6% rate of return until the fourth year.

As a further development, Westcoast contracted with Trans-Northwest Gas for the sale of gas at the Canadian border for delivery to the Spokane area. This company proposed a $0.06 per Mcf higher rate than that proposed for Portland and Seattle, to improve its earning position.

There can be no question of preferable economics in the case of a larger diameter pipeline from Canada if the volume of gas could be sold with certainty over a long period of time; but, in this case, there was considerable question of the availability of this large industrial market at the proposed rates.

Pacific Northwest Pipeline Corp.

The program of this company provided for the purchase of large, proven gas reserves "in place" in the San Juan basin; the purchase of gas in the fields adjacent to the proposed line in the Rocky mountains area; thence, serving all market requirements in southern Idaho and in the populated areas of Washington and Oregon. Despite several tax benefits, which helped the economic program of the project, the firm market requirements of the Northwest were inadequate to support the initial plans; therefore, contractual arrangements were made for the sale of 100 MMcf per day to Colorado Interstate Gas Co. at a point near both Rock Springs and Green River, Wyo. The latter company now has a line under construction that will convey this gas to the Cheyenne and Denver markets. This agreement increased the first year volume of firm, long-term contract gas sales by approximately 40%. Thus, the longer distance involved in the Pacific Northwest project was more than compensated for by this greater volume.

Fish Northwest Constructors Inc., Houston, received a contract to design the Pacific Northwest pipeline to serve these volume requirements, depending on industrial sales as a sole means of

Pacific Northwest

Ray C. Fish, chairman of the board and director. From 1927-1930, Mr. Fish was in charge of engineering and constructing natural gas extraction plants in the California and Mid-Continent areas for the J. A. Campbell Co. Following this, he was operating manager of the oil and gas division of Stearns-Roger Manufacturing Co., Denver, for the next 14 years. He was then made a vice president of Tennessee Gas Transmission Co., where he was responsible for all design, engineering, construction, and the preliminary operation of the natural gas transmission project. In 1946 he left TGT to organize Fish Engineering Corp.

Fish Constructors Inc. was organized by Mr. Fish in 1948 to handle the engineering, design, and construction of the $247 million Transcontinental Gas Pipe Line Corp. system. He then directed the design, engineering, and station construction of the $130 million line built for Texas-Illinois Natural Gas Pipeline Co. Fish Pipeline Construction Corp. was formed in 1950 to do the job. Also in 1950, Mr. Fish organized, with a group of associates, the Pacific Northwest Pipeline Corp.

C. R. Williams, president and director. As a graduate chemical engineer, Mr. Williams was associated with the Continental Oil Co. for 12 years in many positions of responsibility, culminating as general manager of its oil and gas division. Then, in 1942, he left Continental to become vice president in charge of operations for the Chicago Corp. He served in this capacity until 1945 when added responsibilities with the Chicago Corp.'s subsidiaries were given him. He came to Pacific in 1951.

Robert T. Herring, vice president and director. Bob Herring got his start in the oil and gas business in west Texas; he was general manager of an oil and gas operation in Breckenridge.

In 1949 he became associated with Ray Fish and since that time has served as assistant to the president of Fish Engineering Corp. He has served as consultant to many natural gas transmission and distribution companies and has personally directed the engineering, design, and construction of numerous distribution systems.

Leon M. Payne, secretary, assistant treasurer, and director. Mr. Payne, an economist and lawyer, joined the law firm of Andrews, Kurth, Campbell & Bradley, Houston, in 1939. He became associated with Pacific Northwest during its formative and promotional period. Mr. Payne is vice president of Spokane Gas & Fuel Co. and assistant secretary of Fish Engineering and four other Fish-controlled companies.

Fish Northwest

Richard Ricketts, president. Mr. Ricketts' first gas industry job was with the Columbia Gas & Electric System, where for nine years he participated in design, engineering, operation, and maintenance of compressor stations, gas pipeline systems, gasoline plants, etc. He then joined Panhandle Eastern and was a key figure in that company's 1936-37 expansion program.

As one of the founders and vice president of Fish Engineering, Mr. Ricketts participated in a managerial capacity in the design and construction of the Transco and Texas-Illinois pipelines.

Arthur B. Allyne, project engineer. From 1926-1937, Mr. Allyne was a research chemist for the Shell Oil Co. of California and for 10 years was chemist and chemical engineer with Southern Counties Gas Co. He joined the staff of the public utilities division of the California Railroad Commission in 1937 and progressed to senior gas engineer.

After the war, Mr. Allyne became gas engineering consultant on the staff of Ebasco Services Inc. Until 1951, he was responsible for numerous engineering and economic studies of many types of gas properties and systems. During 1950-51, he served as project manager for the new gas system of East Tennessee Natural Gas Co. He left Ebasco in 1951 and became assistant general manager of the Honolulu Gas Co. Ltd. and Pacific Refiners Ltd. in the Hawaiian Islands.

James W. Hall, project manager. Bill Hall worked for several companies as driller, transfer clerk, chainman, rodman, levelman, transitman, and mapping draftsman immediately after getting out of school. He was also a researcher on spot welding galvanized tanks, did specialty layout and fabrication of structural steel and sheet metal items, and was foreman of a tank production crew. He then joined Missouri-Kansas Pipe Line Co. as a party chief.

Mr. Hall resigned to enter the pipeline construction business for himself and was vice president and general manager of Eastern Construction Co. until 1948 when he joined Fish Constructors Inc. He was superintendent of construction for the Transco project and became Transco's superintendent of pipeline until his affiliation with Fish Northwest for the Pacific Northwest project.

K. C. Biederman, construction superintendent. Ken Biederman first obtained part and full-time employment with H. H. Atwell, Ann Arbor, Mich, in 1937 doing surveying and small construction. From 1941 to 1949, he was with Panhandle Eastern in capacities ranging from instrument man to resident engineer on pipeline construction. He left Panhandle to become division superintendent for Fish Constructors during the construction of Transco's line.

From 1951-1953, Mr. Biederman was with Brown & Root Inc. as pipeline superintendent. From 1953-1955 he was an engineer with River Construction Corp. He joined Fish Northwest in March of this year.

Fish Engineering

Robert A. Daugherty, general manager. Bob Daugherty was with predecessor companies of the Texas Co. and with that firm from 1927-1930, when he left to go with Superior Oil Co.

Mr. Daugherty joined Fish Engineering in 1950. He was originally project engineer in charge of gasoline plant projects, and later was made project manager on the Phillips pipeline. He served as vice president of Fish Engineering Corp. of South America and as project manager on the Shell Oil job in Venezuela.

J. R. Imber, vice president and treasurer. Mr. Imber began his career with the Texas Co. in field pipeline work, then progressed through field warehouse and clerical operations. In 1946, he joined Fish Engineering Corp. as accountant, with title of assistant secretary and treasurer. In 1947, he became secretary-treasurer. In addition to his officership in Fish Engineering, Mr. Imber is currently vice president and treasurer of Fish Northwest Constructors.

C. B. Ames, vice president. Mr. Ames joined Stearns-Roger in 1934 and for 12 years designed, engineered, and constructed various types of natural gas and dehydration plants for Panhandle Eastern and many others.

Since 1946 to date, he has held his present office with Fish Engineering. When Fish Constructors Inc. was organized, Mr. Ames was made vice president and directed the construction for the Transco system. He held a similar position with Fish Pipeline Construction Corp. during the construction of the Texas-Illinois system.

O. L. Mullen, manager of construction. Mr. Mullen's first experience with the gas industry was gained during the six years he was in the engineering department of Northern Natural Gas Co. He was then associated with Stearns-Roger for nine years before he joined Fish Engineering Corp. in 1945 as general construction superintendent in direct charge of constructing dehydration plants, natural gasoline plants, compressor stations, etc. From 1948 to date, Mr. Mullen has had the additional responsibilities with Fish Constructors Inc. as general superintendent of compressor station construction.

maintaining relatively steady flows in the transmission facility rather than as a prime market.

Several advantages were to be realized from the purchase of gas "in place." Phillips Petroleum Co., the previous major owner of the reserve, had drilled some 77 wells to prove the reservoir and to delineate its limits, but an additional 150 wells would be required to provide sufficient deliverability for the requirements. Pacific Northwest took over this obligation and contracted to pay Phillips an overriding royalty, which amounted to only about one-half of the price of gas in the field. Although the investment required to drill the additional wells is considerable, Pacific Northwest can take the tax advantages of the intangible drilling costs and the depletion allowance. Thus, considerable savings can be effected.

In addition, the purchase of the gas in place in its reservoir means that Pacific owns the recoverable liquid content of the gas and an extraction plant has been designed that will recover about 300,000 gal. per day of butane, propane, debutanized natural gasoline, and other marketable hydrocarbons. Revenue from this source inures to the benefit of the service to be rendered.

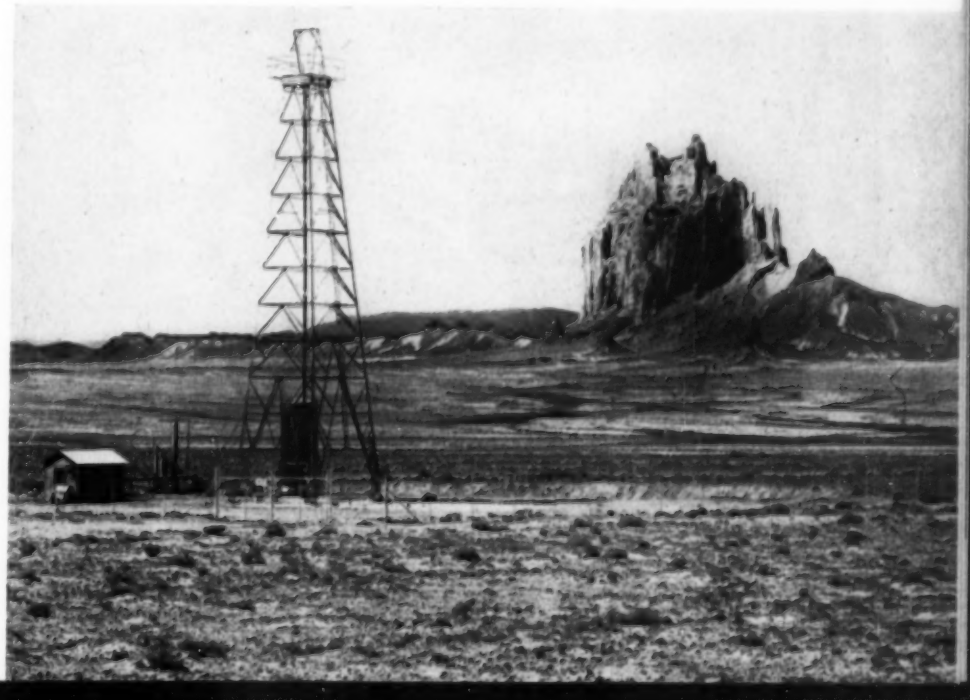
Upon completion of these contracts and the design factors that followed, the rates established for the sale of the gas were approximately the same as those proposed by Westcoast for the Portland and Seattle market and were $0.06 per Mcf cheaper than the Trans-Northwest rates. These rates were established on the basis of a full 6% to 6½% rate of return on the capital investment even in the initial years.

There has been considerable comment to the effect that Pacific's line is under-designed; however, it is a basic point in the natural gas transmission industry that the facility should be designed to meet the clearly established requirements of the market area, and that is what Fish Northwest Constructors has done. Pacific's line will cost about $163 million and, as is the case with all interstate gas transmission lines, it will have to operate under the Natural Gas Act and regulations promulgated by the FPC, which, in the final analysis, will allow Pacific to earn a reasonable rate of return on a declining rate base. This declining rate base is normally at the rate of 3% per year, so after operating for just slightly longer than three years, the invested capital will be reduced by 10% of $16.3 million. A thorough study of the system indicates that a 30% looping program for the entire pipeline would increase the investment by less than $30 million and, as is obvious, in three years Pacific will have depleted approximately half of this looping cost. This looping program would increase the volume of gas through the pipeline by approximately 23 to 24% over the initial design volume for the initial pipeline system* (293 MMcf per day). Ths is the method that the gas transmission industry has developed for growth that can pay its own way as the market requirements increase. The reason some transmission companies have experienced the necessity of increasing their rates is primarily because of increases in the cost of gas

Pipelining country? Not exactly ideal—but this is typical of the terrain Fish Northwest Constructors is up against in Colorado and Utah. In spite of the rugged topography, Fish Northwest is on schedule with the construction of the Pacific Northwest pipeline. The Colorado River may be seen flowing through the valley (top center).

*See "Initial Pipeline System and the Expansion Program."

High above the thirsty plains and mesas of southern Colorado and northern New Mexico, venerable Shiprock stands guard over the sand, sage brush, and the ghosts of fabled Indian warriors. This marker can be sighted to the southwest from Pacific Northwest's right-of-way.



at the fields and not because of growth in transmission facilities. Pacific Northwest will grow in this manner.

The FPC

To form an idea of the complexity and involvement of the FPC hearing, some of the statistics relating to the procedure are as follows:

1. Approximately 95 intervenors either opposed or supported one of the projects.
2. Twelve of the major financing houses in New York were active in one way or another.
3. Four major engineering firms were involved as participants or as expert witnesses.
4. Four nationally outstanding consulting geological firms were active in the hearing.
5. The hearings consumed 196 hearing days before the FPC.
6. Some 28,600 pages of testimony were heard.
7. Six hundred and fifty separate exhibits were filed during the hearing.

To complicate things, various California gas companies, along with El Paso Natural Gas Co., opposed the Pacific Northwest project. Some of the gas distribution companies supported the Westcoast project while others supported the Pacific Northwest plans; also, the lawyers of the coal and railroad industries were present to oppose all natural gas pipeline plans.

Plans had to be revised as opposing forces made their stands felt; for instance, Pacific had originally planned to include Salt Lake City as a delivery point and sell gas there as well as in the environs. Too, it wanted to purchase gas from the Clear Creek field in Utah, but these ambitions failed to materialize when an El Paso Natural-controlled local system outbid them. Thus, the Colorado Interstate contract resulted.

After that deal, there was a proposition by a second local company, Colorado Western Pipeline Co., to build a pipeline from the San Juan basin to Denver, but the higher cost of gas (due to smaller volumes) for the new company coupled with the desire of Colorado Interstate to increase its facilities north of Denver and to exploit the reserves of the western slopes of Colorado, gave advantages greater than the new company could offer.

When the scope and seriousness of the opposition are considered, it seems obvious that the basic planning of Pacific Northwest had to be extremely sound; in due time, then, actually on June 18, 1954, Pacific Northwest was issued the vital FPC certificate of public convenience and necessity authorizing it to construct and operate the proposed pipeline system.

It is interesting to note that Pacific Northwest is now, in some measure or other, favorably involved with most of the competition it faced in the FPC hearings. It has entered into contracts with Westcoast for the Canadian gas; it has acquired the former assets of Trans-Northwest Gas Inc.; it has integrated a portion of Northwest Natural's personnel with its own; and it has entered into a contract for the sale of gas to El Paso Natural Gas Co., which was one of the more formidable intervenors. This would seem to be its own tribute to a top flight management team.

Looking north from Grand Junction, Colo. into the approaches of Douglas pass through which R. H. Fulton & Co., under contract to Fish Northwest, has built Schedule 4 of the 26-in. pipeline for Pacific Northwest. Fulton's spread made it look easy—actually, it wasn't.

Financing

With a certificate in hand containing authority to build the pipeline and other facilities Pacific Northwest planned, the next step was arranging for some $163 million required for the project. It was reasoned that this would be facilitated if the gas reserves of the Canadian company, Westcoast Transmission, could be used properly in the United States. Market studies indicated that it would be feasible to supplement Pacific's gas reserves with those of Westcoast and accordingly, a contract was executed in December 1954 between Pacific, Westcoast, and El Paso Natural Gas Co. which provided, among other things, for the purchase of 300 MMcf/day of gas by Pacific from Westcoast starting 18 months after the Pacific project goes into operation. This additional gas, Pacific feels, it can sell in its own markets in the near future, will also be available for California markets if and when satisfactory arrangements can be made between the interested parties. In this contract, however, is a provision that Pacific can interrupt any future supply to California should an interruption of delivery at the international border force this undesirable action.

After the Canadian gas agreement was consummated, Pacific completed its financing arrangements in New York City. Previous stockholders for common stock financed about $15.5 million; a group of underwriters, headed by White, Weld & Co., financed $20 million through sale of "packaged units" (consisting of one share of common stock and one 5½% interim note, $60 principal amount) priced at $72 per unit—said unit produced $69.55 to Pacific; $26.8 million was obtained as unsecured bank loans from J. P. Morgan & Co. Inc. and the First National City Bank of New York, at 3.5% interest (maturing serially from 1958 to 1962); and $93.2 million was generated as first mortgage bonds at 4.25% interest, due 1975, the pur-

chasers of which were 10 life insurance companies, trustees of a pension trust of Bethlehem Steel, and J. P. Morgan & Co. Inc., Agent. The sinking fund will start after the bank loan retirement.

Initial Pipeline

As certified by the FPC, the pipeline system designed for Pacific Northwest by Fish Northwest Constructors Inc. (Houston) will have a delivery capacity of 343 Mcf of natural gas per day when powered by 14 major compressor stations. However, the initial pipeline system that the Pacific organization has financed and Fish Northwest will construct at this time, will have a system delivery capacity of 293 MMcf per day when powered by the five compressor stations presently to be constructed. Pacific acquired considerable gas producing acreage in the San Juan basin and under the initial plan it intends to drill approximately 144 wells as additions to the 77 gas wells previously completed.

Under the expansion program, the capacity of Pacific's line will be increased from 293 to 343 MMcf per day during the first and second years of operation. Additional compressor horsepower will have to be added and 136 additional wells will be drilled in the San Juan basin. This program will involve approximately $20,725,000 additional capital investment.

Management Team

Many of the key personnel in Pacific Northwest Pipeline Corp., the company that will operate the new pipeline following its turn-key completion, and in Fish Northwest Constructors Inc., the company that has the responsibility of designing and supervising the construction of the pipeline, are pipeliners with years of experience gained in the dynamic technological accomplishments of the Fish Engineering Corp. (Houston).

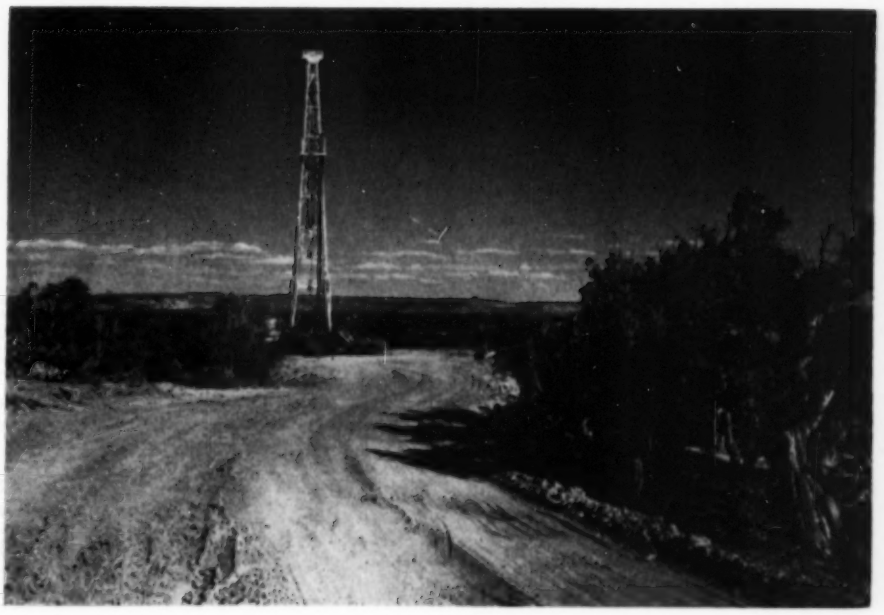
Ray C. Fish formed Fish Engineering in 1946 after leaving Stearns-Rogers Manufacturing Co. (Denver), to supply engineering services to the petroleum, gas, chemical, petrochemical, and other industries where technology finds its way to the forefront. R. D. Ricketts, C. B. Ames, D. L. Mueller, and A. J. L. Hutchison joined Mr. Fish in forming the company and helped build the record that Fish Engineering Corp. holds today. Since those early days, Fish Engineering Corp. has marked its progress with the following outstanding gas industry milestones:

Gas storage plants, Peoples Gas Co. western Pennsylvania — $12 million; gasoline extraction plants—throughout the Southwest—$50 million; carbon black plants—$1 million; oil refinery—Hawaii—$3 million; gas compressor stations — throughout the industry — $50 million; Transcontinental Gas Pipeline Corp.—Texas-to-New York—$250 million plus $7.5 million additions; Texas Illinois Pipeline Corp.—Texas-to-Illinois—$130 million plus $5 million additions; chemical plants—at various locations—$20 million; ammonia plant—Phillips Chemical Co., Pasadena, Texas — $30 million; and many others.

Because the engineering company has many projects underway for different companies at all times, it was considered advantageous to form Fish Northwest Constructors Inc. to design and build so vast a project as the Pacific Northwest gas pipeline. Fish Engineering's personnel are carefully selected engineers with 10 to 15 years operating experience in their fields. It is the philosophy of this organization to hold a "striking force" of engineers capable of taking on jobs that would be bogged down in preliminary design were it not for the wide experience and technical concepts of this group; therefore, the nucleus to staff Fish Northwest Constructors Inc., coming as it does from the engineering company, is actually seasoned pipeliners and construction engineers with all the "know how" one could wish for.

Fish Northwest Constructors has grown from seven people to more than 450 in just four short months. Many experienced pipeliners have joined the Fish Northwest company to form an organization that has done more design and construction on a pipeline in less time than has ever been done before—and done it well, too. For instance, in just about 60 days after closing of the financing on May 3, 1955, Fish Northwest's crews completed 1100 miles of survey permitting, staked out 900 miles of right-of-way, purchased 500 miles of right-of-way, and were laying pipe. This is moving pretty fast in anybody's language.

In addition to the contract with Fish Northwest Constructors Inc. to design and build its pipeline, Pacific Northwest has contracted with Fish Northwest for the actual construction of compressor stations, dehydration units, and a processing plant. The design of these facilities will be done by Fish Engineering.



A rotary rig is drilling away for natural gas in the San Juan basin, near Blanco, N. M. Reserves from this field form the major source of gas that will be delivered to the Pacific Northwest and, possibly, to California. If plans are certificated, this gas may be used for exportation to Canada on a temporary basis.

Part 2 →

"The Scenic Inch"

PART 2

Pipeline Design

GOOD engineering is the prime criterion of a sound, economically practical pipeline. A concept is rampant in the gas industry that to build a good pipeline one must engineer with the thought in mind of including elaborate remote control devices, semi-excessive instrumentation, and generally "dress it up." Fish Northwest Constructors has not followed this concept—it included a minimum of items smacking of automation and sophistication. However, the line is well engineered to do its designed task of transmitting natural gas in adequate volumes for the market with complete safety, dependability, and practicality. Fish Northwest's philosophy is: the embellishments can be added later, if at all; for the time being, let's get a good, sound pipeline built in accordance with all accepted engineering practices and get it operating on schedule. That is exactly what they are going to do.

Under the plans for the initial pipeline system, 1067 miles of 26-in. and 22-in. OD pipeline will be constructed from Ignacio, Colo., to the Columbia river near Pendleton, Ore. From there, either Plan I or Plan II will be constructed. Plan I is as certificated at the present time; that is, to build the pipeline on into the Pacific Northwest with 18-in. OD pipe from the Columbia river to Portland, 14-in. OD pipe from Portland to near Seattle, 8-in. diameter past Seattle, and finish off with 6-in. diameter on up from Seattle to Bellingham. The lateral to Wenatchee, Wash. will be 6-in. diameter and the lateral to Spokane will be 10-in. diameter pipe under this plan.

Since certification, the agreement with Westcoast has been entered into, so to provide adequate pipeline capacity for the imported Canadian gas, Plan II was devised and presented to the FPC for authorization. This proposed plan will bring 26-in. OD pipe down through Washington to join the 22-in. OD near Pendleton and, as a sidelight, Pacific Northwest proposes to sell natural gas to Westcoast Transmission in the first year of the former's operation for resale to British Columbia Electric Co. Ltd. who will market it in the Vancouver, B. C. area. This gas will be delivered to Westcoast Transmission at a point on the International Boundary near Sumas, Wash. This exportation of U. S. gas will terminate at such time as Westcoast is prepared to serve this customer with Canadian-produced natural gas, but not prior to July 1, 1957. In the event Plan II becomes certificated, it will necessitate Fish Northwest increasing its designed horsepower for compressor stations.

A lateral involving 43 miles of 10-in. diameter pipe, along with necessary dehydration and booster facilities, will be built from the Piceance Creek gas field to a tie-in point with the main transmission line at Rangely, Colo. Another feeder lateral will be constructed to bring natural gas into the system from the Big Piney and Tip Top fields in southwestern Wyoming. This lateral will be 50 miles of 6- to 16-in. pipe and will tie in near Kemmerer, Wyo. Other small diameter laterals and gathering systems have been certificated.*

Fish Northwest Constructors Inc. has divided the line from Ignacio to the Columbia river into 12 schedules for construction. The shortest schedule is 73.6 and the longest is 114 miles. Also, schedules have been set up for the Piceance Creek and Big Piney laterals.

Contracts have been entered into with various pipeline contractors. Construction is well underway and moving along on schedule. The successful contractors and their schedules are:

Schedule 1—River Construction Corp., Dallas, covering 75 miles of 26-in. OD mainline from Ignacio to north of Cortez, Colo. Started July 5, 1955, working south.

Schedule 2—River Construction Corp., covering 75 miles of 26-in. OD mainline from Cortez, Colo. to Moab, Utah. Started July 13, working north.

Schedule 3—R. H. Fulton & Co., Lubbock, Texas, covering 73.6 miles of 26-in. OD mainline from Moab to north of Grand Junction, Colo. Started July 20, working south.

Schedule 4—R. H. Fulton & Co., covering 86 miles of 26-in. OD mainline from north of Grand Junction, through Douglass pass, to Jenson, Utah. Said to be the toughest schedule on the route, it was kicked off June 6, working north and making pipeline.

Schedule 5—Associated Pipeline Contractors Inc., Houston, covering 77.6 miles of 26-in. OD mainline from Jenson to the tie-in with Colorado Interstate's line near Rock Springs, Wyo. Started June 20, working south and will pass through some of the most scenic country on the entire right-of-way, also a tough section.

The following contractors were scheduled to begin work between Sept. 1 and 10.

Schedule 6—A. J. Curtis Construction Co., Casper, Wyo., covering 82.8 miles of 22-in. OD mainline from near Rock Springs to a point near the Wyoming border. Will work south.

Schedule 7—Montin-Benson Corp. & G. G. Griffis Inc., covering 90 miles of 22-in. OD mainline from near the Wyoming-Utah line to near Bannock, Idaho. Will work south.

Schedule 8—Midwestern Constructors Inc., Tulsa, covering 95 miles of 22-in. OD mainline from Bannock to Burley, Idaho. Will work north.

*When building a long distance gas transmission line, several mileages will be encountered for the distance between the same specific points. The first is usually the mileage as certificated by the FPC. This is based on preliminary aerial surveys and may not be exactly accurate, but it is the accurate basis for certification.

Following the issuance of these mileages, the right-of-way is permitted and staked by more accurate ground surveying. These mileages agree in principle with the previous survey, but they may vary by minute distances therefrom.

Then, actual pipeline mileages result when the pipe is put in the ground. These may vary by small distances from both the previously mentioned surveys.

The mileages mentioned herein are generally those certificated by the FPC and are the result of aerial surveying and some ground civil engineering surveys. Thus, the actual pipeline miles may differ slightly from spread to spread as construction is finished.

Schedule 9—H. B. Zachry Co., San Antonio, covering 100 miles of 22-in. OD mainline from Burley to near Mountain Home, Idaho. Will work south.

Schedule 10—H. B. Zachry Co., covering 114 miles of 22-in. OD from Mountain Home to Ontario, Ore. Will work north.

Schedule 11 — Fulghum Construction Corp., Harrisburg, Pa., for 98 miles of 22-in. mainline up to Baker, Ore. Will work north from Ontario, Ore.

Schedule 12 — Fulghum Construction Corp., for the last 100 miles of 22-in. mainline that will terminate at the Columbia river near Pendleton, Ore.

Schedule 26A—A. J. Curtis Construction Co., for 21 miles of various diameter gathering system in the Big Piney gas field.

Schedule 26—A. J. Curtis Construction Co., for 54 miles of 16-in. OD lateral from the Big Piney field to the mainline. This section is completed.

Schedule 27A—R. H. Fulton & Co., for 16.9 miles of various diameter gathering system in the Piceance Creek gas field.

Schedule 27—R. H. Fulton & Co., scheduled for 43 miles of 10-in. diameter lateral line from the Piceance Creek gas field.

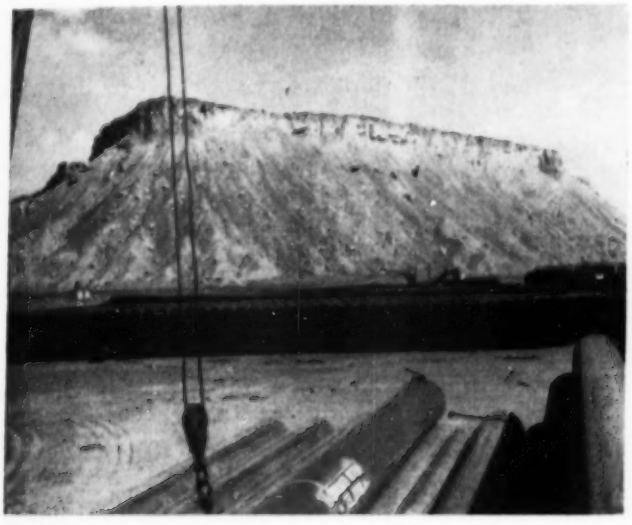
These spreads pass through terrain that is as historic and scenic as any in the United States. High altitudes, inaccessibility, extremely steep grades, heat, dust, and rock are major deterrents that are being faced. Later, cold weather will complicate the situation.

The line has been designed in strict compliance with the recommendations set forth in the gas industry's own safety code—ASA B31.1.8-1955, Gas Transmission and Distribution Piping Systems. In fact, in many design factors, it has been Fish Northwest's policy to go one step further than the code when designing. This policy was developed to produce a pipeline that assures maximum, practical safety in the public interest and at the same time provides for minimum maintenance in relation to the economics involved.

Pipe

The line pipe for the transmission system is being fabricated to comply with API Std. 5LX-52E, Class III, specifications. Popularly, it is known as X52 line pipe. The steel is produced by

Fig. 1. Fish Northwest's design calls for 26-in. OD pipe in the segment of Pacific's line from Ignacio, Colo., to near Green River, Wyo. . . .



The 26-in. pipe is stockpiled . . .

loaded on trucks . . .

hauled out for stringing . . .

and 26-in. pipeline is made.

Scenic Inch... Other wall thicknesses have been designed where considerations warranted it

the electric furnace process and from it the pipe is fabricated by cold working and expanding, and continuous electric welding. The basic line pipe in the 26-in. OD part of the line has an 0.281-in. wall thickness, an inside diameter of 25.438 in., weighs 77.25 lb per ft, and has been hydrostatically mill tested at 1010 psig. For the 22-in. OD segment of the transmission line, the pipe has a wall thickness of 0.250 in., an inside diameter of 21.500 in., weighs 58.07 lb per ft, and has been mill tested at 1060 psig. Other wall thicknesses have been designed into the pipeline where special design considerations have warranted it.

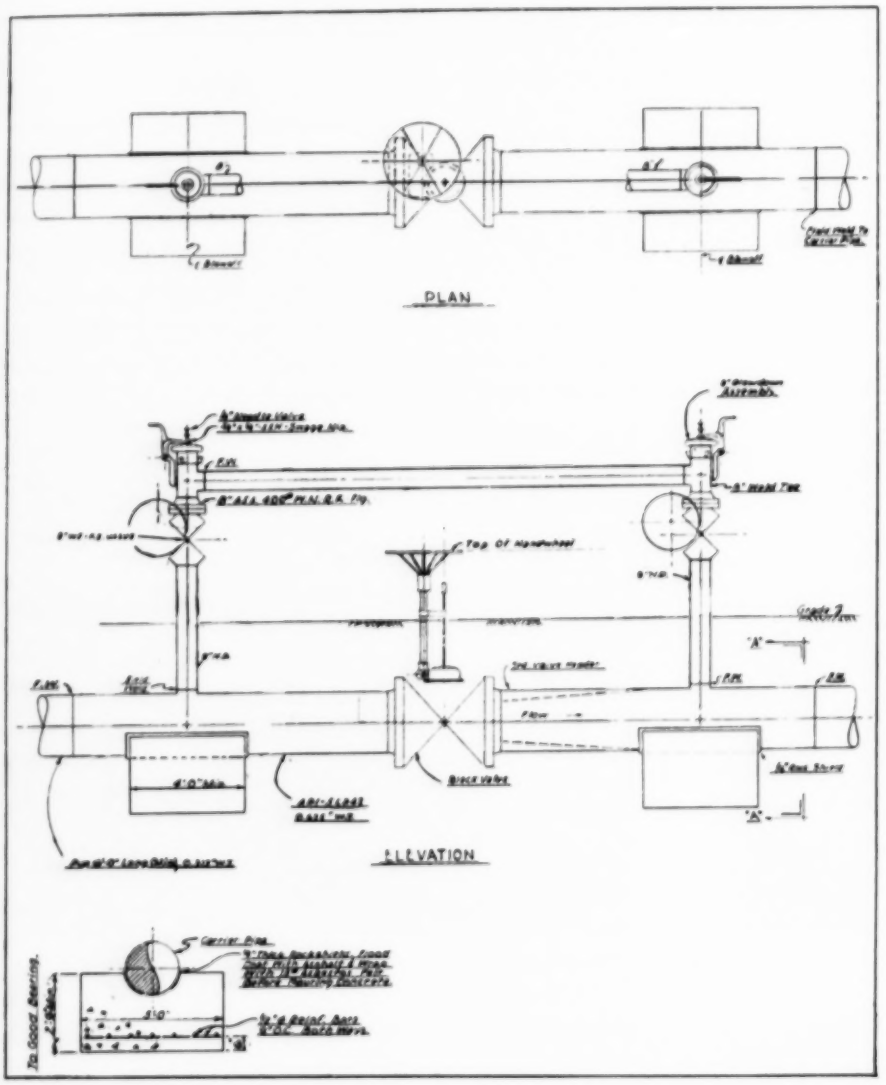


Fig. 2. A typical mainline block valve unit.

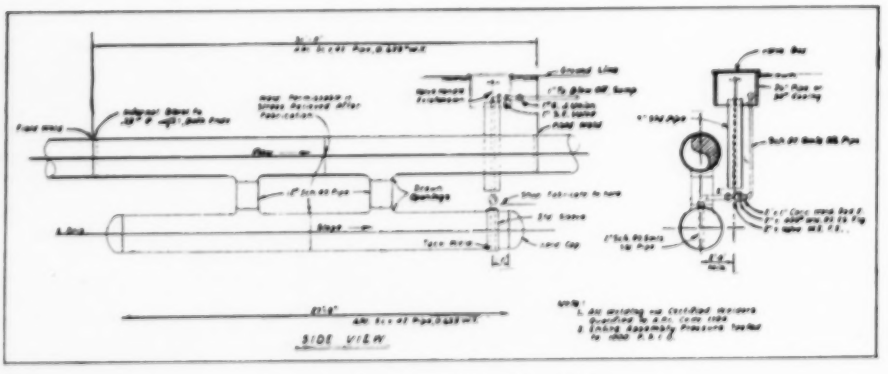


Fig. 3. Typical mainline drip design.

Weldability of pipe

Weldability of this X52 pipe in the field, as observed during an August visit to the working spreads, appears to be generally good. API 5LX-52 is a high chemistry pipe that at times can be on or beyond the border line of weldability by ordinary field procedures. The chemical specifications for the pipe are:

	Ladle Analysis	*Check Analysis*
Carbon, % max.	0.28	0.32
Manganese, % max.	1.25	1.30
Phosphorus, % max.	0.04	0.05
Sulfur, % max.	0.05	0.06

Weldability is usually measured in the pipeline industry by the carbon equivalent formula:

$$\text{Carbon equivalent} = C + \frac{Mn}{4}$$

From this formulation, 0.60 is the upper limit for weldability (using ordiary field procedures) set by some welding engineers, while others specify 0.65 as the maximum for this factor. As can be seen by applying the values from the chemical specifications table to the formula, X52 pipe can have a carbon equivalent as great as 0.645, which is either over or just on the border line, depending on a personal point of view.

The pipe manufacturers aim at carbon and manganese contents well below the specified limits and only small percentages of the total product have chemistry that will give a carbon equivalent above the accepted limits. The few welding flaws observed certainly seemed to be the result of poor welding technique rather than the relatively high chemistry of the pipe material. It should be added that the Fish Northwest welding inspectors (they all must pass the welder's qualifying test before being employed) were also catching the few welding imperfections observed by *GAS'* editor. Alva Bartley, Fish Northwest chief inspector on Spread 1, and a veteran welder himself, was well pleased with the weldability of the pipe on his spread. As in all the construction operations on the Pacific Northwest project, contractors for Fish Northwest Constructors have

to closely follow the welding standards set up in the ASA B31.1.8-1955 Code and AWS procedures.

Pipe fabrication

The 22-in. and 26-in. OD line pipe is being fabricated for Fish Northwest by Kaiser Steel Corp. at Napa, Calif., and Consolidated Western Steel division of United States Steel Corp., Provo, Utah, on an approximately equal tonnage basis. (See Construction Progress.)

Special, heavy-wall pipe for river crossings and other specific points is being fabricated by Bethlehem Steel Co. and National Tube division of U. S. Steel Corp.

Smaller diameter steel pipe for laterals and gathering systems will come from Lone Star Steel Co., Daingerfield, Texas, and others.

Mainline Block Valves

Block valves are to be spaced on the mainline at approximate 15-mile intervals. They are not being installed during the heavy construction phase. The entire assemblies will be fabricated as units under a separate contract and cut-in later.

Rockwell-Nordstrom lubricated plug valves will be used for the blocks throughout the pipeline. Fish Northwest has selected the Hyperseal type in a venturi pattern with welding ends. A recovery tube has been specified. The valves will be in the 400-psig class and will be manually operated with a handwheel on a water-tight extension.

Risers

The upstream and downstream risers will be 8-in. nominal diameter, 0.500-in. wall, API 5L-Grd. B, seamless pipe that will be field welded to integral extruded outlets (where deliverability permits), which will, in full accordance with the ASA B31.1 Code, eliminate the need for reinforcement at the weld with conventional pad and saddle type construction.

An 8-in. Rockwell-Nordstrom WE-FE plug valve is designed into each riser and there will be a Thornhill-Craver Unibolt blowdown assembly on each riser. The bypass run will be 8-in. nominal diameter, 0.322-in. wall API 5L-Grd. B, seamless pipe. The mainline valves will be founded on reinforced concrete blocks to resist reaction from the jet effect of large volume gas blowdown. A drawing of a typical block valve unit shown in *Fig. 2*.

Valve sizes for the block valve installations will be:

On the 26-in. OD line . . . . 26-in. x 20-in. x 26-in.

On the 22-in. OD line . . . . 22-in. x 18-in. x 22-in.

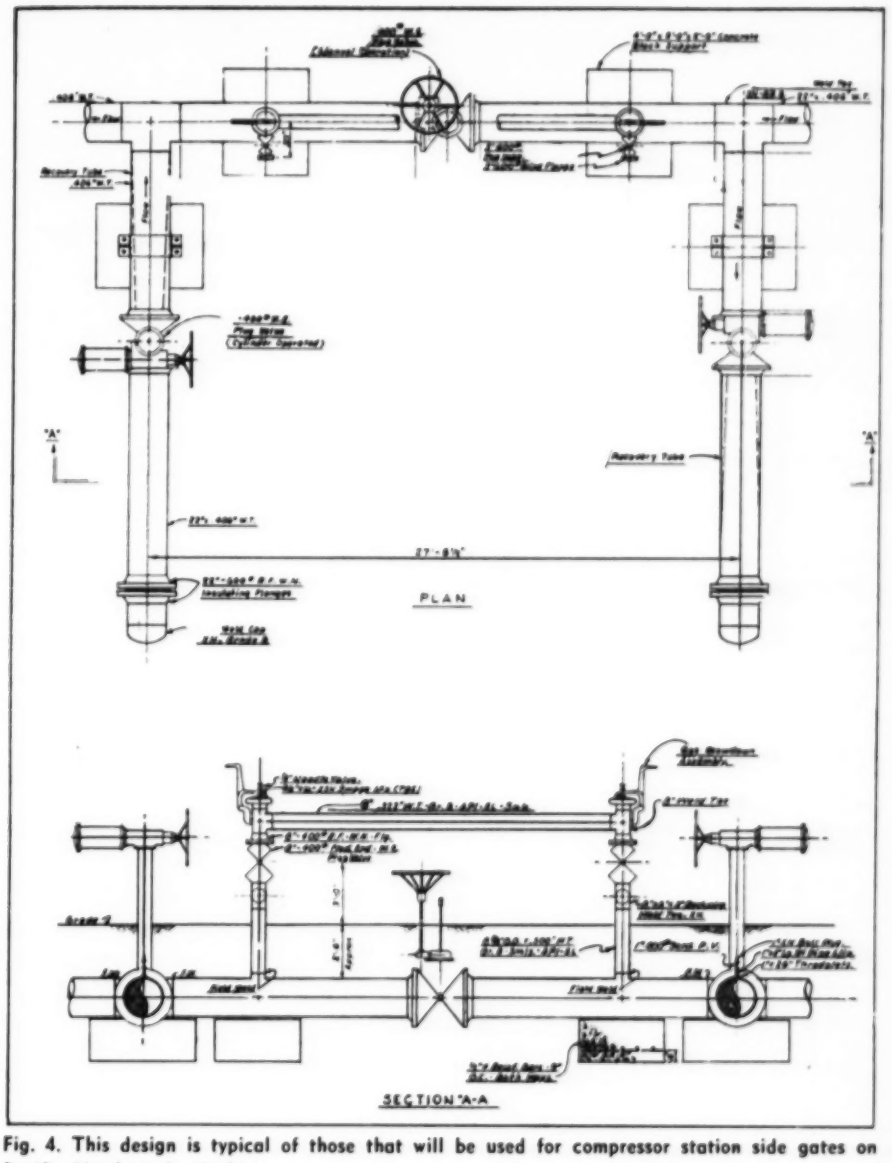


Fig. 4. This design is typical of those that will be used for compressor station side gates on Pacific Northwest's pipeline.

Drips and Side Gates

The design of the drips is very straightforward as can be seen from the drawing shown in *Fig. 3*. The outstanding feature is the use of integral extruded outlets for branch connections, which, again, eliminates the necessity of branch weld reinforcement.

Compressor stations side-gate assemblies will be as indicated on the design shown in *Fig. 4* and are similar in most detail to the design for the mainline block valves. The valves on the inlet and outlet will be equipped with valve operators and will be the same type valve as the blocks. Recovery tubes will be used as was the case with the blocks. The connections will be attached to the mainline through the use of welding tees. Compressor fuel will be bled off from a connection on the station intake line and discharge line.

These assemblies will be installed during the heavy construction phase and blanked off until the compressor stations are completed.

Crossings

Fish Northwest Constructors has exceeded the minimum requirements of the ASA code in the design of crossings.

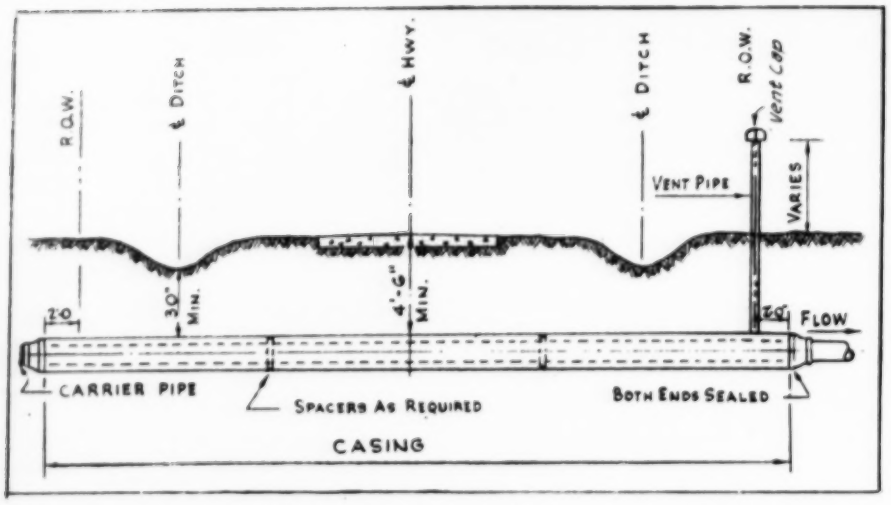


Fig. 5a. Typical elevation of a highway crossing design

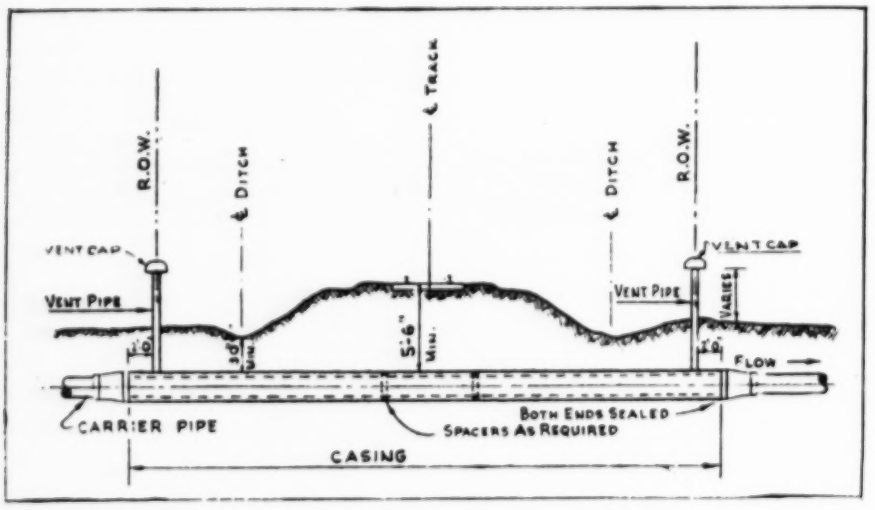


Fig. 5b. Typical elevation of a railroad crossing design.

TABLE 1. DESIGN OF RIVER CROSSINGS

Crossing	Distance	Description
Colorado river	2000 ft hdr-to-hdr	Dual 20-in. OD lines
Green river No. 1	1000 ft hdr-to-hdr	Dual 20-in. OD lines
Green river No. 2	660 ft hdr-to-hdr	Dual 20-in. OD lines
Green river No. 3	1500 ft hdr-to-hdr	Dual 20-in. OD lines
Snake river No. 1	1000 ft hdr-to-hdr	Dual 16-in. OD lines
Snake river No. 2	900 ft hdr-to-hdr	Dual 16-in. OD lines
Columbia river	4400 ft hdr-to-hdr	Dual 20-in. OD lines

TABLE 2. COMPRESSOR STATIONS UNDER CONSTRUCTION

Station	Approximate Location	No. & Size of Engines	Make
1	Ignacio, Colo. — the focal point of the San Juan basin gathering system.	6 - 2000 slhp	Clark TLA-6
2	Near Moab, Utah	4 - 2000 slhp	Clark TLA-6
6	North of tie-in with Colorado Interstate Gas Co.'s lateral near Rock Springs, Wyo.	4 - 1500 slhp	Cooper-Bessemer GMWA-6
7	North of Kemmerer, Wyo.	3 - 1500 slhp	Cooper-Bessemer GMWA-6
9	Between Pocatello and American Falls, Idaho	3 - 2000 slhp	Clark TLA-6

The scenic inch... Pipe will "go the code one better"

Since most of the Pacific Northwest pipeline will pass through territory that can only be called Class 1 (see para. 841.011 in ASA B31.1.8-1955), it would be permissible to cross under privately owned roads with Type A (see Code, para. 841.02) construction and under public roads with Type A construction and casing. However, Fish Northwest has specified Type B construction (uncased) for private roads and Type B cased for all county, state, and federal roads. What this works out to is that they have specified 0.344-in. wall thickness pipe for the private roads, i.e., they are going the code "one better."

The highway crossings that will be cased have a casing schedule as follows:

Pipe Size	*Casing*	*Vent Riser*
4"	8"	2"
6"	10"	2"
8"	12"	2"
10"	14"	2"
12"	16"	4"
14"	18"	4"
16"	20"	4"
18"	22"	4"
20"	24"	4"
22"	26"	4"
24"	28"	4"
26"	30"	4"

Most of the highway crossing on the mainline constructed under the initial pipeline system will be 22-in. carrier pipe with 26-in. casing or 26-in. carrier pipe with 30-in. casing. Four-in. vent risers will be used by both. Specifications call for the use of F. H. Maloney Co. (Houston) casing insulators (a combination insulator and spacer) and casing seals. The seals are particularly unique in that they can be installed rapidly because of the use of a zipper that seals to shut out liquids and dirt. Additional pressure tightens the seal of the zipper. Spacers are to be placed at 12-ft OC intervals for pipe 6-in. diameter and larger, and at 6-ft OC for pipe smaller than 6-in. diameter.

Special vent cap

The vent risers will be capped with an insect- and weather-proofed vent cap

of a special design made by Kelley Manufacturing Co. (Houston). Vents will be connected to the lower end of the casing only.

The railroad crossings are essentially the same design as the highway crossings. The minimum cover is increased a bit in deference to the deeper barrow ditches and heavier loads that are expected from trains, and two vents will be used—one at either end of the casing. The casing schedule is exactly the same for both types of crossings.

Typical railroad and highway crossings are shown in *Figs. 5a* and *5b*.

River Crossings

In the type of terrain that Pacific's pipeline will pass through, there will be numerous minor rivers, streams, dry washes, arroyos, etc., that will require special attention. There are seven river crossings that Fish Northwest Constructors feel are worthy of the name in the 1955 construction program, and more for 1956.

The southernmost river crossing is that for the Colorado river near Moab, Utah. Then, about 160 miles up the pipeline, there is the first of three crossings that have to be made on the Green river. These three Green river crossings are within a 60-mile section of the line. Near Mountain Home, Idaho, the first of two Snake river crossings will have to be made. The second time this river is traversed will be near Ontario, Ore. The northernmost crossing will be made on the venerable Columbia river near Pendleton, Ore., practically on the Oregon-Washington border. The latter operation promises to feature a lot of action for engineering and construction personnel.

The design of the crossings is shown in Table 1.

Pipe for crossings

The pipe for the first four 20-in. crossing lines will be 20-in. OD with 0.625-in. wall thickness and is being fabricated by Bethlehem Steel Co.; pipe for the 16-in. lines will be 16-in. OD with 0.843-in. wall and is being supplied by National Tube division of United States Steel Corp. The 20-in. Columbia river crossing will be 0.812-in. wall thickness pipe from National Tube.

Wherever possible the weight necessary for submerged river crossings is being put in the steel, subject to the availability of heavy wall pipe.

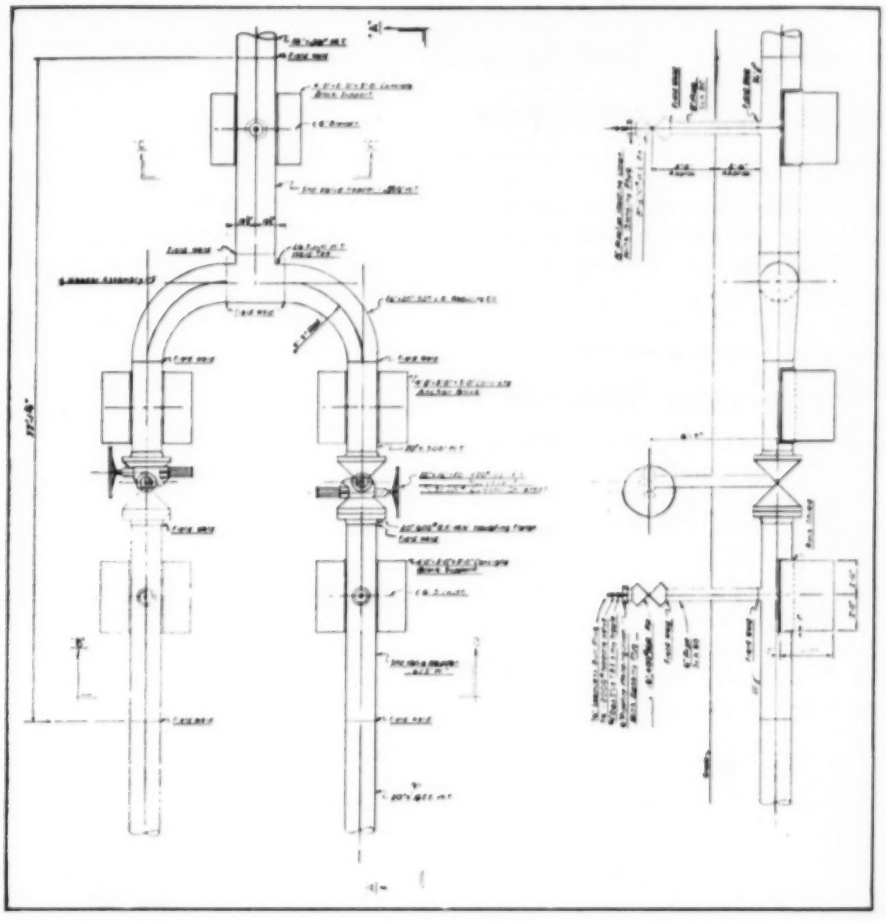


Fig. 6. Submerged crossing layout for a river intersecting the ROW of Pacific's line.

The minimum cover has been set at 10 ft, where test borings indicate that maintenance of this dimension is feasible. Although the specially thick wall pipe has been specified and it is probable that this weight would give the line adequate negative buoyancy, Fish Northwest Constructors has again gone one step further and specified (in somes instances) the installation of 1900-lb each, bolt on, concrete river weights for both legs of the dual crossing lines. The river weights are being supplied by Jack G. Walker Co. (Houston).

The drawing shown in *Fig. 6* is a typical river crossing, dual line header. The design features a heavy-walled welding tee to make the transition from a valve header into two 90°, long-radius reducing elbows. Class 400 psig Rockwell-Nordstrom lubricated plug valves are installed at both ends of each pipe run in the dual line crossing. These valves are the venturi pattern with welding ends on the header side and flanged ends on the dual carrier line side. They are equipped with elevated gearing to facilitate the installation of valve operators after the heavy construction phase is completed. Recovery tubes are to be installed on the downstream side of the valves to reproduce desirable flow characteristics in the gas stream. The header illustrated is for a crossing in the 26-in. OD part of the pipeline that will have twin 20-in. OD submerged lines. The headers for the crossings in the 22-in. OD segment of the line will be basically the same. The crossing for the Columbia river may not be at all similar to the designs described herein because this crossing will be a special and intricate engineering problem that is still in the process of design and decision.

Western rivers have a tendency to be rough in season. There are periods of relatively little rain or snow and consequently resulting periods of drouth are experienced. Such periods followed by heavy rains and snow run-offs make the river crossing job formidable because during the maximum run-off periods these rivers are particularly likely to produce excessive scour and bank erosion. Soil stresses to the coating of the submerged lines may be expected to be

Scenic Inch... Two booster stations scheduled for present construction

excessive; therefore, the lines that will pass under the rivers will be given a double coating for surety in maintenance of cathodic protection.

Compressor Stations

Five main transmission-line compressor stations, representing 36,500 hp at sea level, are scheduled for immediate construction. Fish Northwest is now planning on the basis of 81,120 hp, sea level, currently under design by Fish Engineering under the initial pipeline system and as initially certificated by the FPC. Should Plan II be certificated by FPC, additional compressor station horsepower will be designed and installed.

Engines have been ordered, some station sites acquired, and some construction has begun on the five stations currently being installed (see *Table 2*).

Two booster stations are also scheduled for present construction. One is at the Piceance Creek gas field and is designed for two J. B. Beaird Co. 330-hp packaged compressors to boost wellhead pressures as needed. The other booster will be five 660-hp Ingersoll-Rand engines that will be used for a station at the Big Piney gas field. Other Ingersoll-Rand engines will be used in mainline compressor stations planned for later construction along the line.

One of the most interesting aspects in the design of the compressor stations is the high altitudes at which a number of them will be installed. This is reflected as follows:

Station No.	*Elevation, ft*
1*	6627
2*	5970
4	5400
6*	6118
7*	6302
8	6130
9*	4438
10	4118
11	3128

The remaining stations are basically at sea level.

In all, 16 compressor stations with 99,400 hp, sea level, are contemplated for eventual construction under Plan I or Plan II; however, since Plan II is a proposed program that cannot be acted upon unless authorized by the FPC, as previously mentioned, 81,120 hp is now under design and some of these will not be installed until 1958. The compressor capacity and power will develop as the pipeline, market, and load are developed. Thus, the policy of expansion when expansion can pay its own way, is again illustrated.

Compressor station No. 1 is designed along conventional lines and will be located upstream, but adjacent to, the extraction plant at Ignacio, Colo. It will use electric power to drive aerial cooling water fans, starting air compressors, and other auxiliaries. This station is at relatively high elevation, so the installed sea level horsepower of 12,000 (six 2000-hp engines) will be derated to 10,020 hp at 6626 ft. It is designed for 450 psig suction pressure and 800 psig discharge, which will be the process pressure for the extraction plant immediately downstream. Six 2000-slhp Clark TLA-6 engines will be installed.

The other stations will be self sustaining and the engines will be unitized. In a few words, this means that each engines will have and drive its own auxiliaries as a unit rather than having central facilities for cooling jacket water, oil cooling, water pumping, etc. The unitized type of design was developed because Fish Engineering and Fish Northwest engineers feel that this system will (1) lower the installation cost, (2) produce greater dependability, and (3) lend itself more favorably to automatic control.

Each unitized engine will have an integral jacket cooling-water pump and finned aerial jacket-water cooling fan. The water-cooling fan unit will be driven through six V-belts that transmit power from the compressor engine drive shaft to a belt and pulley drive connected to an Imo pump that energizes a hydraulic system to 350-400 psig. The fan end of the mechanism has another Imo pump that serves as a motor when hydraulic fluid is pumped through it. A hydraulic coupling and a speed increaser gear box transfer its energy as torque to the fan shaft. To vary the speed of the fan, more or less hydraulic fluid is bypassed around the

*Scheduled for immediate construction.

Fig. 7. Fish Northwest Constructors car, equipped with VHF mobile radio unit, parked along the ROW in Schedule 1 while inspector looks over clean-up job.

Fig. 8a (right). Cleaned and primed 26-in. pipe drying on skids.

Imo motor working as a pump, in direct relation to the engine-jacket cooling-water temperature. The Imo pump, a product of the De Laval Steam Turbine Co., Trenton, N. J., has three rotors resembling worm or helical gears that inter-mesh to produce full axial flow. These are the only moving parts, and the rotors are in hydraulic and dynamic balance, which eliminates intermittent strokes, churning, and pocketing.

Each unitized engine has its own water cooling fan and drive for it. In addition, each has its own lubricating oil cooler that takes a sidestream from the circulating engine-jacket cooling water. Actually, everything needed by the engine is driven therefrom and is located thereto except the small starting air compressors, one electric motor-driven and one natural gas engine-driven.

Neither the compressor engine manufacturers nor the compressor operating personnel of Fish Northwest have complete experience and data on the performance of the engines at high altitudes. This will be one of the great unknowns until some operating experience is gained; however, the compressor station designers feel that they actually have a cushion after the engines are derated. Actually, the engines are designed and rated for operation at 110° F at sea level, while out in the Rockies where these engines will be powering the Pacific Northwest pipeline, the maximum loads will be experienced during the winter when ambient temperatures will be cool enough to have the air temperature below 32° F on any given peak day. Conversely, the maximum summer ambient temperature for the stations with some altitude to consider will seldom exceed 95° F and, if it does, this should be during a period of minimum demand or load for the engines. In addition, with 2000-slhp engines derated to 1760 hp at the higher elevations, there will be a cushion because the bearing loadings, cross head loadings, etc., are designed for the full 2000 hp. Factors such as these, you might call them safety factors, will more than compensate for any lack of experience with compressor engines at elevated altitudes.

Altitude vexed the designers when they calculated capacities, pipeline efficiency, etc. All popularly accepted flow and efficiency formulas depend upon the basic assumption of isothermal flow with negligible changes in elevation; however, in the case of the Pacific Northwest pipeline, neither can be assumed. Coupled with this is the continuous marketing along the route of the line, the firm large volume delivery to Colorado Interstate, the injection of gas into the line from various gas fields along its route, and the interchange of gas. All of these design factors influenced the Fish Northwest Constructors' engineers in the selection of the compressor engines.

Reciprocating engines were chosen because of the flexibility in compressor operation that will probably be necessary due to the previously mentioned factors. They are advantageous for widely varying loads and compression ratios. Wide range cylinders will allow efficient compression over a wider range of conditions than in the case of combustion gas turbines, etc. For instance, Fish Engineering has designed for carrying maximum loads with the reciprocators at or between compression ratios of from 1.18 to 2.2. The Turbiflow supercharged type was selected in deference to the high altitude, and most of the engines will be scavenged by centrifugal blowers driven by the engine drive shaft.

The compressor stations, as installed, will be manually operated, but are designed for automation at a later date. They are, however, designed to meet or better the provisions if the ASA B31.-1.8-1955 code, so automatic block valves are provided in the compressor station side gates and for station blowdown. The valve operators for these tasks will be electric at station No. 1 and natural gas-powered at the others. Conventional valve operators will be used for this purpose. Heavy wall pipe, 0.406-in. W.T., mill tested to 1460 psig, will be used for the side gates and will be run for 1000 ft on the discharge side of the compressor stations.

There will be more to the design of these unusual compressor stations, but most of it will be better said after completion of the stations. For instance, station No. 14, due to its location, will probably be designed to pump three ways, depending upon the source of gas and load conditions.

Fig. 8b. The dope gang jumps over a hill and works on up the line applying the protective coating and wrapper. Fig. 9 (right). Asphalt base pipeline enamel stockpiled at various points along the path of construction. Enamel is trucked to spreads as supply is needed.

Measuring Stations

Conventional-type gas measurement and pressure regulating stations will be used. This will involve about 99 separate stations to date, and undoubtedly many more will be added to the pipeline as the market is developed. These include town border stations for the existing utilities with which Pacific has firm delivery contracts, commercial con-

Scenic Inch... Microwave system will have three voice channels in addition to a service channel

sumers, and industrial customers.

Most of the installations will be single or dual orifice meter runs; however, there will be some positive meter installations as well as positive and orifice meter runs, in manifold.

Generally speaking, the design of these measurement installations has not been firmed up. Fish Northwest Constructors is doing the design and installation of these stations and the company contemplates setting up 10 customer classifications, based on load, and having standard meter and regulator installations for each classification. In most cases, they have contracts that specify a 14.73 psia pressure base, which will considerably simplify measurement operations.

Recording calorimeters and gravitometers will be installed at strategic locations.

Communications System

Fish Northwest is designing and plans to install one of the longest, privately owned microwave radio systems in the world. Bids have been taken for a 1250-mile hypothetical path for the microwave channels from Ignacio, Colo., to Portland, Ore. This preliminary work is based on assumed locations for base stations, relay stations, etc., and it is estimated that about 40 stations will have to be used along this extensive route. Unofficial estimates for the cost of this system range from $1 to $1.5 million.

The microwave system for Pacific Northwest will have three voice channels in addition to a service channel if preliminary plans work out. After the initial installation of these facilities, they can be expanded to 24 channels, or about 30,000 channel-miles. A considerable system.

A series of prime power stations will probably be required along the microwave path to assure continuity of service during periods of severe weather that is expected over the mountainous, rugged right-of-way of the pipeline. Plans call for remote control of these stations.

In addition to the microwave service, a VHF system will be tied in to it. Applications for licenses for 18 VHF-base stations have been filed with the FCC, and about 100 mobile units will be installed if present preliminary plans are finalized.

The final survey for the microwave facilities was started late in August and is due for completion within 60 days from that time. Fish Northwest has applied to the FCC for necessary authority to operate the communications system.

Presently, 12 VHF mobile units are in operation in the field in Fish Northwest vehicles and are operating on contractors' frequencies to increase the efficiency of the construction operations.

TABLE 3. GENERAL SPECIFICATIONS FOR MODIFIED ASPHALT PRIMERS

Bond strength, 77° F, psi min.	250
Flash point (open tag) ° F, min.	100
Viscosity @ 77° F, (Stormer cup, 100 gms) secs.	20-35 or
Viscosity @ 77° F, (Saybolt Furol) secs.	30-45
Softening point (R & B) dry film, ° F	170-190
Needle penetration, dry film, 100 grams, 5 sec. 77° F, hundredths CM	8-15
Solids percent	30-45
Coverage per gallon, sq ft, min.	400
Drying time @ 85° F, 60% rel. humidity, 1 hr. approx.	

TABLE 4. GENERAL SPECIFICATIONS FOR MODIFIED ASPHALT PIPELINE ENAMELS

Weight, pounds per gal. @ 60° F max.	9.75 to 10.25
Specific gravity	1.18 - 1.24
Flash point, C.O.C.	525° - 575° F
Softening point (R & B)	235° - 250° F
Penetration at 77° F, 100 g/5 sec. cm	4 - 8
Penetration at 32° F, 200 g/60 sec.-min. cm	3
Penetration at 115° F, 50 g/5 sec.-max. cm	19
Blunt rod test - 2 psi, 6 hrs, @ 115° F - max.	.020-in.
Blunt rod test - 2 psi, 100 hrs, @ 85° F - max.	.010-in.
Ash (mineral filler) percent by wt.	19 - 25
High temperature sag test @ 160° F, 24 hrs.	None
Low temperature crack test @ 20° F, 6 hrs.	None
Settlement ratio @ 390° F, 24 hrs, max.	1.02
Peel test, 60° F to 160° F	None
Break test @ 77° F, 1-in. mandrill	None
Water absorption, 35 weeks, max. percent	1.30
Loss on heating - 24 hrs @ 400° F - max. percent	0.60

Corrosion Prevention

A conventional cathodic protection system is planned by Fish Northwest's engineers; however, this will not be accomplished until after the backfill takes its initial set. At the present time, test leads are being attached to the line at approximate five-mile intervals to facilitate the installation of the cathodic protection program. Insulating fittings are being installed during the heavy construction at points that will need to be isolated from the pipe under protection such as at the compressor station side gates, at river crossings, all lateral lines, etc.

Fish Northwest Constructors' specifications call for the entire line to be coated. They will use nearly 100% asphalt base pipeline enamel, although there will be about 50 miles of coal-tar base enamel used in the southern part of Schedule 7. The coating specifications call for a priming coat, a 3/32-in. thick coating of the asphalt-base pipeline enamel, and a fibre-glass wrapper. In addition, the contractors are furnishing a kraft paper wrap to prevent damage to the coating and wrapping during lowering-in and backfilling. The runs in the dual-line river crossing are scheduled for double coating.

Lion E-120 asphalt-base pipeline enamel is being used for the coating on spreads 1 through 5, while Plico No. 620 is being applied on spreads 6 through 8 and very likely will be used for all the spreads through 12. The Lion E-120 is being supplied by the Holcombe Co. Inc., Shreveport. Plico Inc., Los Angeles, is supplying the enamel that bears its name. The glass wrapper is being supplied by Morgan-Wallace Co., Houston; M. J. Crose Manufacturing Co.; and Perrault Equipment Co., Tulsa. The general specifications for the primer and the pipeline enamel are shown in *Tables 3* and *4*. Mavor-Kelley Co., Houston, is furnishing the coal-tar base enamel for the 50-mile section on spread 7.

PART 3 →

"The Scenic Inch"

PART 3

Construction Progress

CONSTRUCTION of a pipeline is a very intricate operation. There is certainly more to it than generally meets the eyes of the public and more to it than meets the eyes of many people in the gas industry whose duties do not bring them in close contact with pipelining in the pure form. These days, most of the actual work is done by contractors and, in many cases, much or all of the design is turned over to organizations who specialize in this technology; hence, the group of gas company people who actually see the construction phases of a major natural gas pipeline becomes smaller and smaller on each job as the art acquires further advancement. Like other industries, the day of the specialist and the special contractor has invaded the gas pipelining segment of our industry.

One result of this failure to penetrate to the actual people and operations in building a pipeline is felt in immediate opposition by the local residents of the areas through which the pipeline is to pass. As is usually the case, the people, or what we might term the public, take the negative attitude that is fostered by rumor, courthouse-step engineers, and the gloom peddlers in general. The impression: a tiger of an uncontrollable big-business corporation is going to spread ruin and destruction throughout the local area.

Fish Northwest Constructors met this problem as have most of the natural gas pipeline companies with recent major construction projects. In the case of Fish Northwest, it has successfully won the local-color boys over to its side by doing a construction job that does not inflict unwarranted damage to local lands and scenery, and by being neighborly with the people who will be the customers and "neighbors" of the Pacific Northwest pipeline. A unique feature of this neighborly concept, call it public relations if you want, is that a Fish Northwest specialist is assigned to each contractor's spread to deal with the public in any claim for damage that arises. Thus, the damage claim is settled for the contractor by Fish Northwest in a manner that reflects the policy that the pipeline will have to "live with" its neighbors for a good many years rather than just until the spread gets over the next hill.

After the initial flurry of opposition was amicably faced-down, the public began to realize what the pipeline will mean to their local areas. Fish Northwest purchased its cars and trucks from local dealers in the area where it would be working. The stockpiling and stringing contractors brought their crews and equipment into the spread areas and these crews needed to be fed, supplied, housed, and entertained in the local towns and cities. Local personnel were hired for many jobs. Instead of damage, the public grasped the salient fact that a lot of money was going to be spent in their towns and that Fish Northwest was going to make every reasonable effort to see that the construction was accomplished with the public's interest and safety under maximum consideration.

The clean-up crews had to do a good

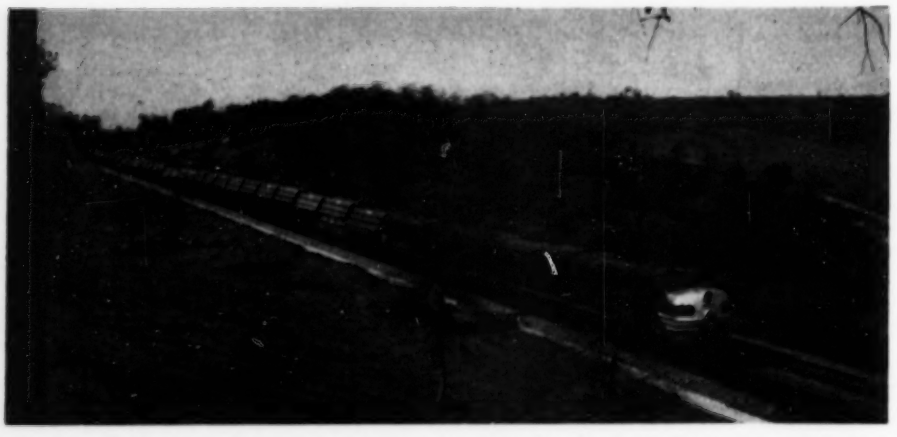
Bulldozer clears and grades access road to right-of-way in Douglas pass. Most roads in the area are unimproved and difficult to drive even in passenger cars.

job to meet this policy. Those that we saw were excellent—as good or better than any we have ever seen. Now, the public knows that prosperity, instead of inconvenience, has come or is coming their way as Fish Northwest brings Pacific Northwest's pipeline through the rugged west on its way to northwestern United States and an eventual junction with our Canadian friends.

The pipeline contractors are also public relations conscious these days. Their payrolls and supplies requirements, amounting to more than $10,000 per day per spread, have been felt in the areas where they are working. All of these factors, combined with the taxes that will accrue to the local political subdivisions and the advantages that will be realized from the availability of clean, convenient natural gas, have more than offset the few disadvantages that naturally result from heavy construction done in a hurry. The people now know that pipeliners are human, their companies are fair, and transmission line construction is in a new era that recognizes the validity of construction with design that includes human relations engineering.

The 26-in. OD and the 22-in. OD line pipe for the Pacific Northwest line is being produced by Kaiser Steel Corp., Oakland, Calif., and Consolidated Western Steel division, United States Steel Corp., Los Angeles, in approximately equal tonnages under order from Fish Northwest Constructors. The production of this pipe and the scheduling of the production and delivery of the two sizes these companies will supply, is a science within itself.

KAISER STEEL'S OPERATIONS



After careful handling, finished pipe is enroute to stockpiles for the Pacific Northwest Pipeline.

At the time of our visits with the steel companies producing the line pipe for the 22- and 26-in. OD sections of Pacific's main pipeline, Kaiser Steel Corp. was producing substantial tonnages of 22-in. OD, API Std. 5LX-52 line pipe with 0.250-in. wall thickness. The steel and steel skelp for the pipe was being produced at Kaiser's Fontana, Calif., steel mill. Hundreds of tests were being made on each 225-ton heat of steel, and the resultant steel skelp, to assure its complete compliance with API 5LX-52 specification. Fish Northwest's specifications require that the finished pipe lengths be furnished in 40-ft random lengths, with an average length of 39 ft, so skelp produced at Fontana arrives at Kaiser's Napa (Calif.) fabricating division plant in lengths of about 40 ft. There, mill scale, rust, dirt, etc., are removed by immersion in a pickling bath.

The pickled plate then travels to an edge-forming machine that shears the plate to exact width, bevels the edges for welding, and produces an initial bend. A "U-ing" press cold forms the plate into a "U" shape by hydraulically pressing with converging side beams. The "U-ed" plate is then fed to the main forming press after being lightly lubricated. This press forms the "U-ed" skelp into a perfect circle by use of half-round dies, each 40 ft long, through application of pressure at 6000 tons. The edges are then perfectly aligned for welding. After tack welding, the seam welding is done in two passes—one inside and the other outside. The inside weld is applied by a traveling boom, moving inside the pipe and positioned by a small wheel riding in the beveled seam. Welding rods are played out to twin arcs, one in front of the other.

The outside weld is also applied with an automatic welder; however, it remains stationary while the pipe moves on rollers underneath. After inspection and dressing, the ends of the pipe, which has been made slightly undersize, are cold expanded. The entire length of the joint of pipe is surrounded by massive restraining dies machined to the exact OD and water is pumped in at sufficient pressure to cold expand the pipe hydraulically. The cold-working does two important things. First, it assures that every length of pipe will be an exact size and in perfect concentricity; second, the cold-working materially improves the grain structure of the steel and results in producing material with a much higher yield strength with no reduction in ductility. Actually, the 22-in. OD pipe is expanded ¾ in. in diameter.

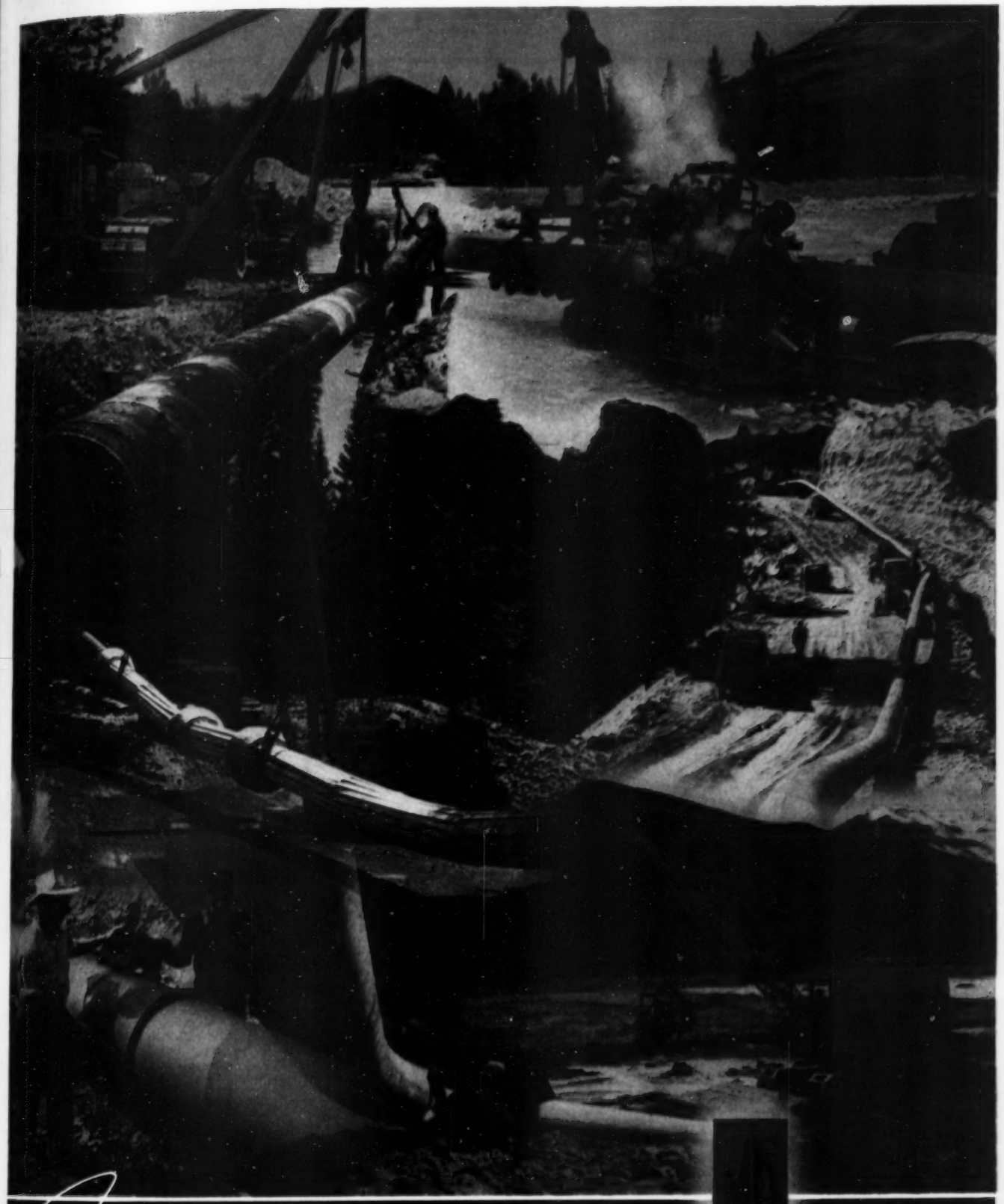
The hydraulic pressure is then reduced to the specified mill test pressure range and the restraining dies are opened. The pipe for the Pacific Northwest line is then subjected to a test pressure of at least 1060 psig while the pipe is rapped by 20 automatic hammers to further test soundness of the pipe and weld. An inspector walks the length of the pipe joint immediately after the hammering checking for any sign of leaking along the weld.

Next, the pipe is dried and the ends are beveled to a 30° welding bevel with a land of 3/32-in. maximum. After final inspection by Robert W. Hunt Co. of Chicago, pipe is ready for shipment.

Throughout the entire process, sampling, chemical analysis, nondestructive testing, and destructive testing are carried out in strict accordance with the latest specifications of nationally recognized testing and technical societies, and the most modern practices in steel pipe making.

The pipe is at this point a perfectly formed, thoroughly tested steel cylinder with machined and beveled edges. Its surfaces are dry and it is ready for shipment to points where Fish Northwest's contractors will stockpile and string it for the pipeline contractors.

For a graphic step-by-step presentation of pipe fabrication process, turn page.



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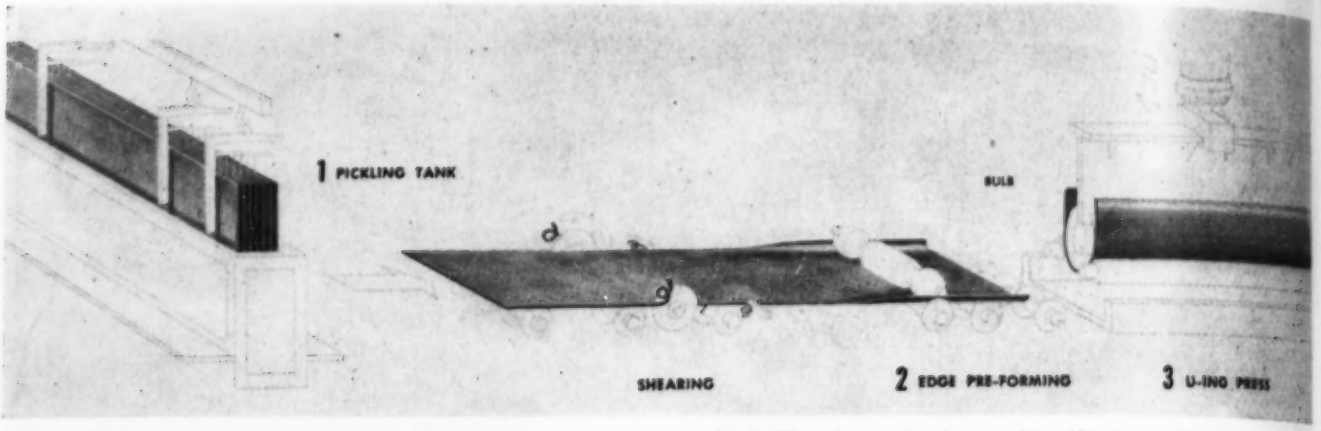
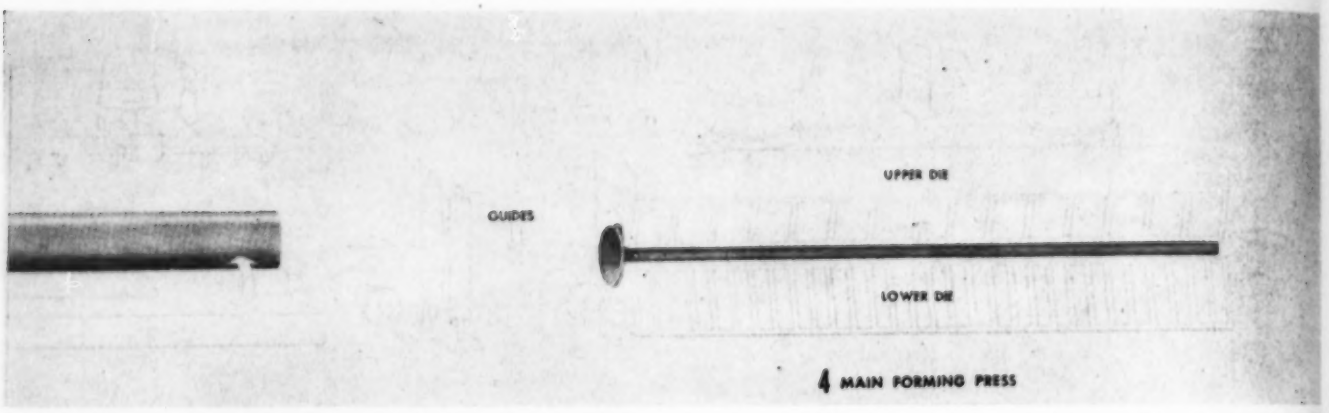
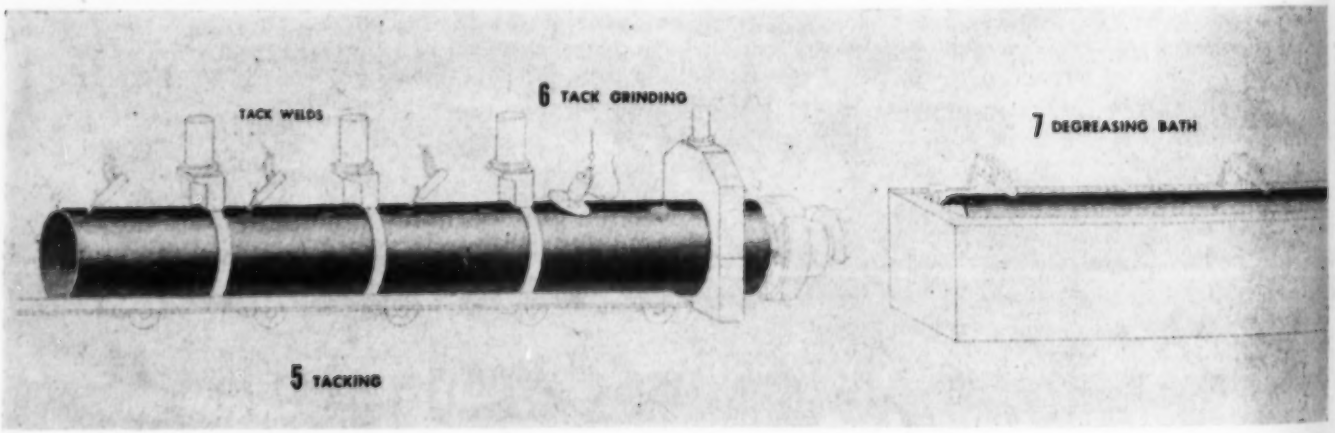


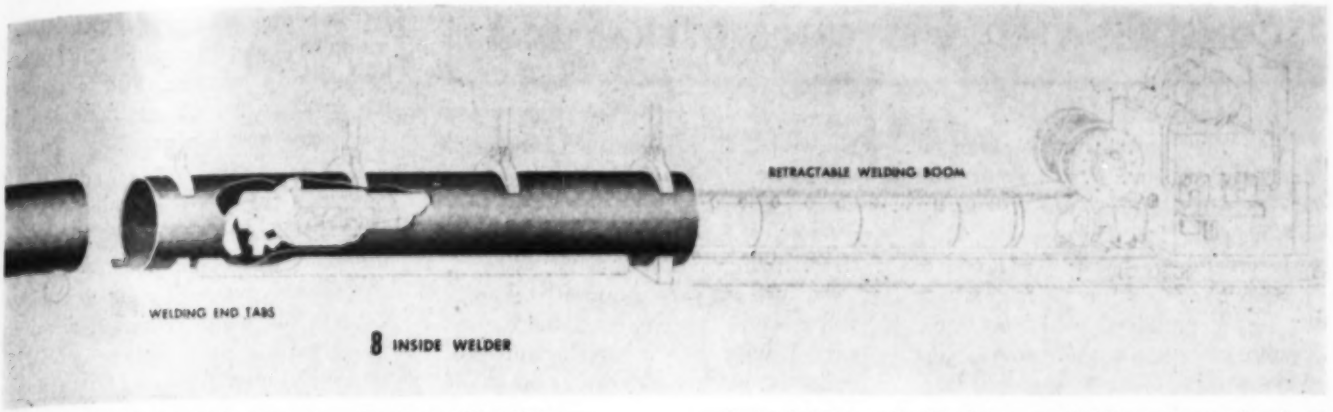
After final inspection at the steel mill, steel plate is delivered to the pipe mill at Napa in 40-ft lengths. There, it is stacked on edge in pickling racks and immersed in a bath of sulfuric acid, water, and soda (1) to remove all trace of mill scale, rust, and dirt. The pickled plate now enters the first operation in the pipe-making "assembly line". The edge preforming machine (2) shears the edges to exact width, bevels them, and preforms the plate by an initial bending of the edges. Immediately, the plate rolls into the U-ing press (3), which in a single operation forms the plate into a U-shape by the action of a downward plunging "bulb" and converging side beams.



After lubrication to prevent galling, the U-shaped plate enters the main forming press (4). Here the plate is positioned in a semi-cylindrical die. A similar upper die, activated by two massive hydraulic rams of 6000-ton capacity, moves downward, forming the U-shaped plate into a cylinder, with the edges perfectly aligned for welding.

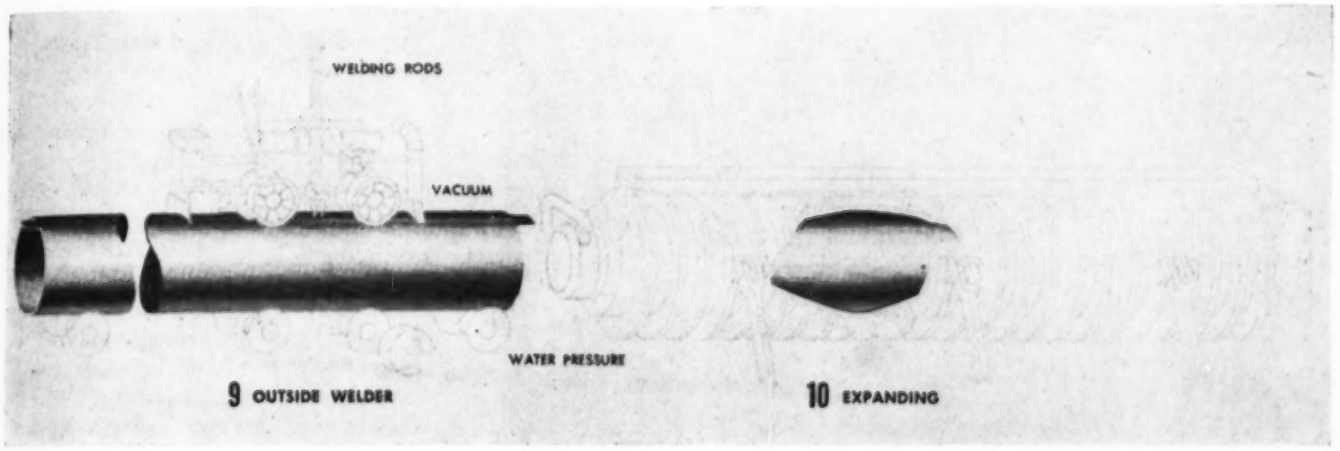


After final forming, edges of the cylinders are tack welded (5). Any offset at the ends is then removed and the tack welds are ground flush (6). The pipe is degreased by immersion in hot water detergent (7) and a 4-in. tab is welded at each end of the seam to assure proper lead-in and cut-off of finish welds. The pipe is welded in two passes, first inside then outside.



8 INSIDE WELDER

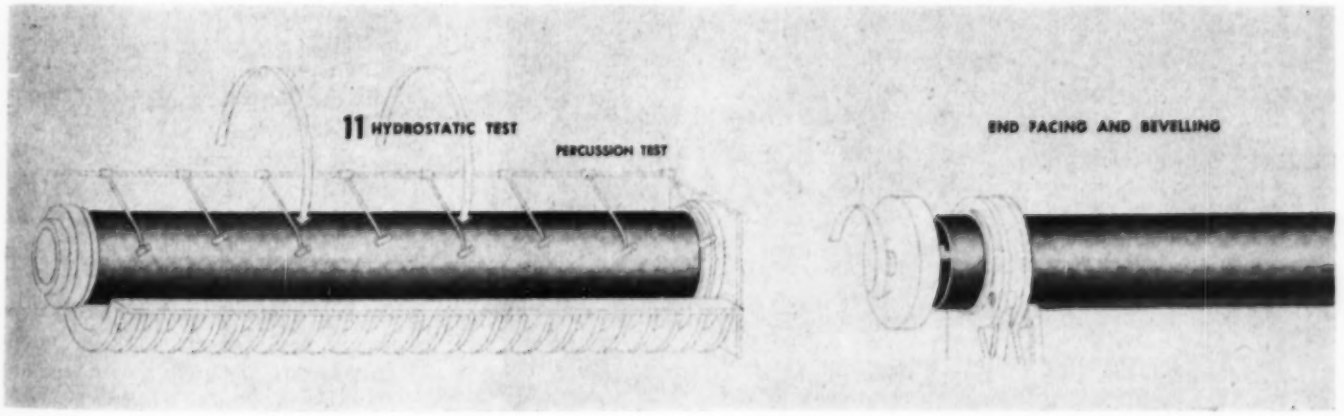
The inside weld is applied by a long traveling boom (8), which moves inside the pipe, positioned with positive accuracy over the seam by a small wheel riding in the beveled seam. Welding rods are played out to twin arcs, mounted in tandem, one in front of the other.



9 OUTSIDE WELDER

10 EXPANDING

The outside weld is applied by a stationary welding fixture (9). The pipe moves on rollers past twin arcs, while the operator maintains accurate seam position by sighting through a rifle sight and making minute radial adjustments. At the expander (10), restraining dies surround the pipe while water at extreme pressure is pumped in, expanding the pipe by cold working the metal to its final accurate diameter, and at the same time sizing and straightening it.



11 HYDROSTATIC TEST

While water pressure is held at testing pressure, restraining dies are opened to permit percussion tests by 20 automatic hammers and visual inspection of the weld before the water is released (11). After drying and precision end facing, each length of pipe undergoes a rigid final inspection procedure.

"The Scenic Inch" PART 3

CONSOLIDATED WESTERN'S OPERATIONS

When the Consolidated Western facilities were visited, they were turning out 26-in. OD, 0.281-in. W.T., API 5LX-52 pipe for the pipeline. They pioneered the process that produces cold expanded steel line pipe. This pipe was being produced at Consolidated Western's Utah pipe mill that is located adjacent to the Geneva Works of U. S. Steel's Columbia-Geneva Steel division, where the steel and plate are produced. Construction was started on the Utah pipe mill on Oct. 1, 1954, and the first carload of pipe for its first customer was produced on April 21, 1955, for Fish Northwest Constructors and ultimate use in the Pacific Northwest pipeline. This is pretty fast construction for steel working facilities. Charles W. Lee, president of Consolidated Western, said, "We are very proud of the progress made by our engineers and the entire working force in erecting this new plant and placing it in operation in less than seven months."

Steel plates come from the Columbia-Geneva Steel division's Geneva Works in the 0.281-in. W.T. and are moved by conveyor from the plate storage area to a magnetic crane that picks up one plate at a time and places it on a conveyor line that carries it to an edge planer, to forming stages where U-ing and O-ing presses form the pipe by cold-working. The pipe is then welded inside and out, and expanded and tested by hydraulic pressure. Fish Northwest has specified a mill test minimum of 1010 psig for this pipe.

View of steel and pipe making facilities at U. S. Steel's operations in Utah, near Salt Lake City. Long, sheet-metal building in the immediate foreground is Consolidated Western's new pipe mill. Directly behind is the Geneva Works of Columbia-Geneva Steel Division.

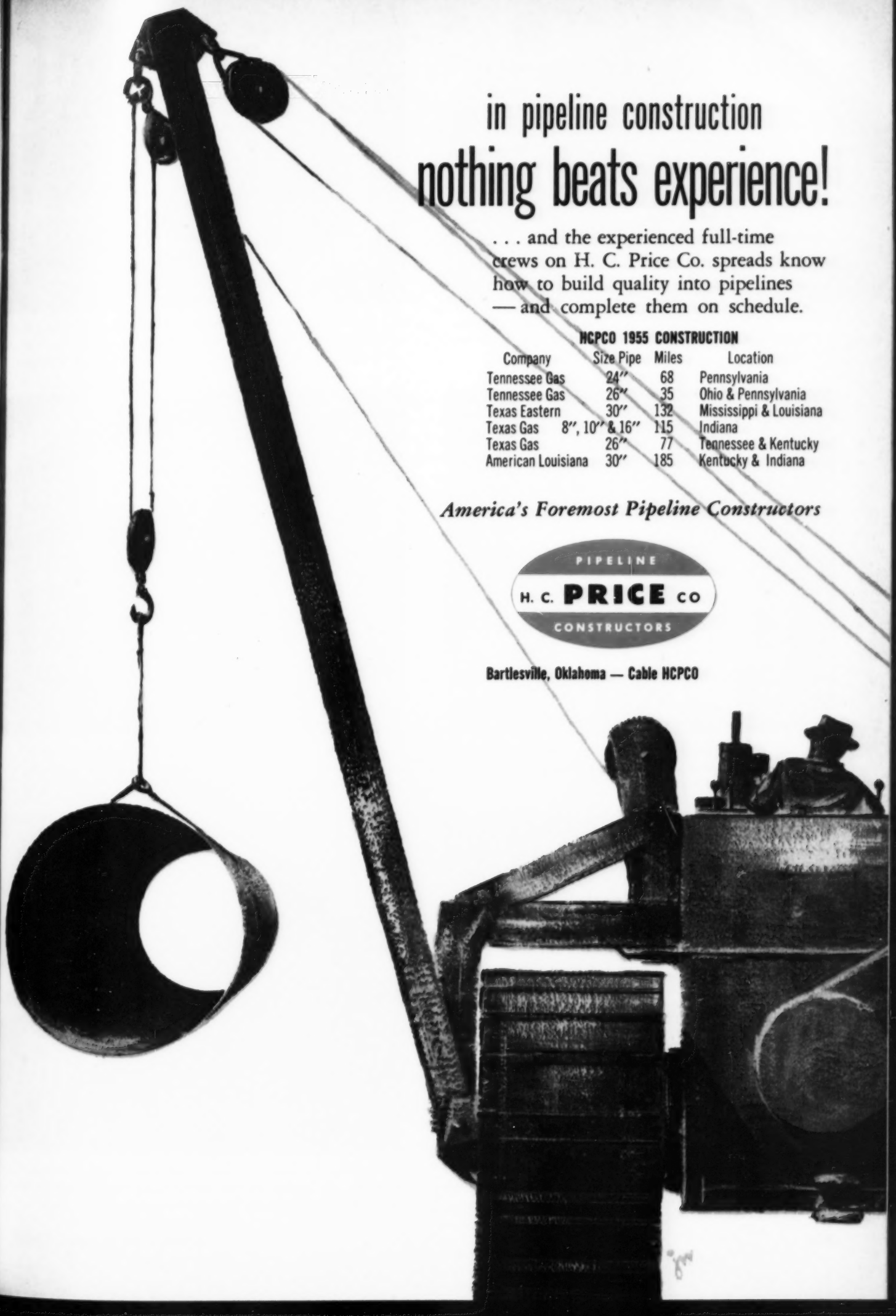
In Consolidated Western's U-ing press, the steel plate is centered over a series of parallel rocker-type dies along the major axis of the plate. A large U-shaped die, operated by the press and as long as the plate, is moved down on the plate forcing it between the dies, which automatically conform themselves to the operation and assist in forming the plate into the U shape.

Consolidated Western's O-ing press is the largest single piece of equipment in the new mill. The giant weighs 750 tons, can exert 18,000 tons pressure, stands 25 ft high, and measures 170 in. wide by 492 in. long. The U-ing press, no small mechanism itself, weighs 375 tons. The expanding press is capable of producing 5000 psig hydraulic pressure to cold-expand the pipe. Again, in this plant as in the case of the other plant described, every care is taken to see that the material and fabrication processes conform with exacting specifications under which it was ordered, and the most modern equipment is available to assure that the pipe delivered to Fish Northwest is as good a product as modern production methods and science can make it.

Following fabrication, inspection, and acceptance of the pipe at both the Napa-Kaiser and the Utah-Consolidated Western mills, it is necessary that the pipe be carefully handled and packed for transporting to the line. This operation calls for special pipe-handling equipment and close cooperation with the railroads, truck lines, and with Fish Northwest so that adequate pipe arrives on the work sites to meet construction schedules.

It is obvious that steel work of the magnitude required to produce the quantity of pipe that will be used in the Pacific Northwest line means work for the steel workers, work for miners, transportation system profit, and the far-reaching, though seldom considered, effect of the new pipeline on the nation's economy and the general public is again obvious.

For a picture story on Consolidated Western's pipe fabrication turn to page 202.



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HCPCO 1955 CONSTRUCTION

Company	Size Pipe	Miles	Location
Tennessee Gas	24″	68	Pennsylvania
Tennessee Gas	26″	35	Ohio & Pennsylvania
Texas Eastern	30″	132	Mississippi & Louisiana
Texas Gas	8″, 10″ & 16″	115	Indiana
Texas Gas	26″	77	Tennessee & Kentucky
American Louisiana	30″	185	Kentucky & Indiana

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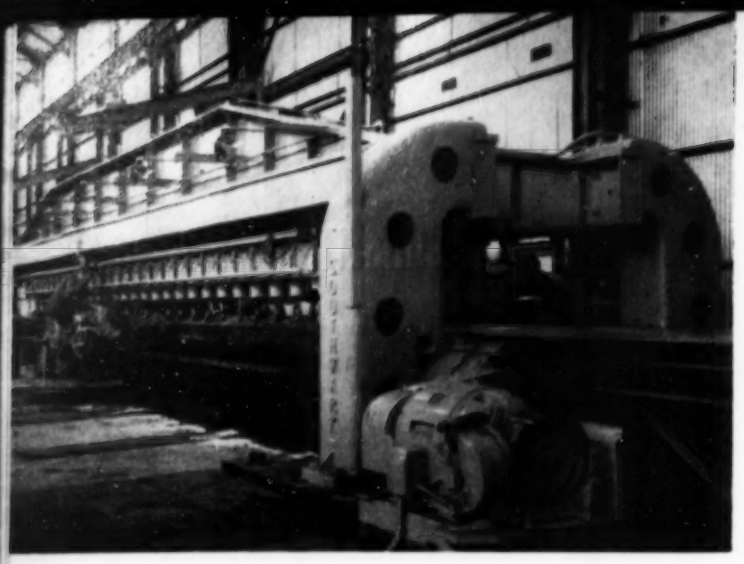
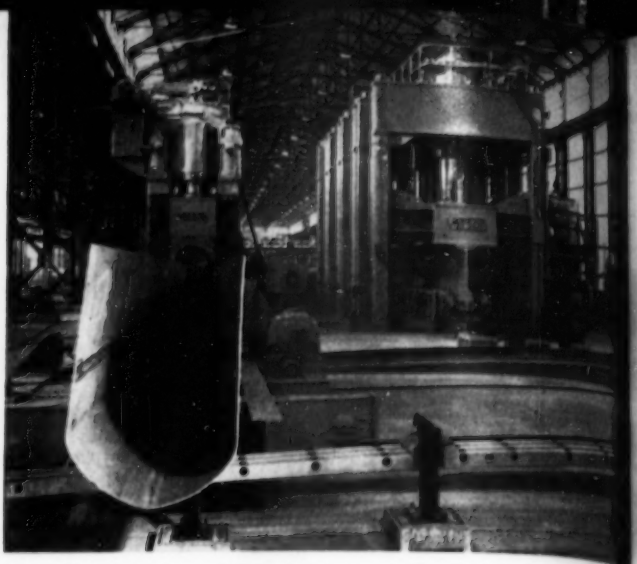
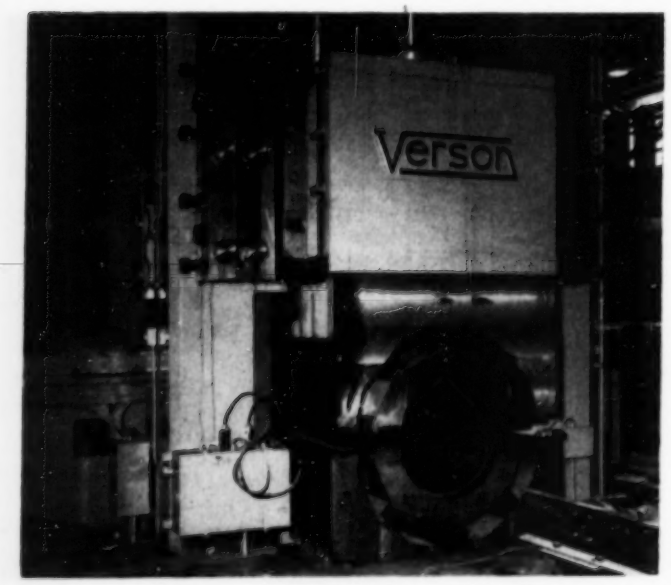


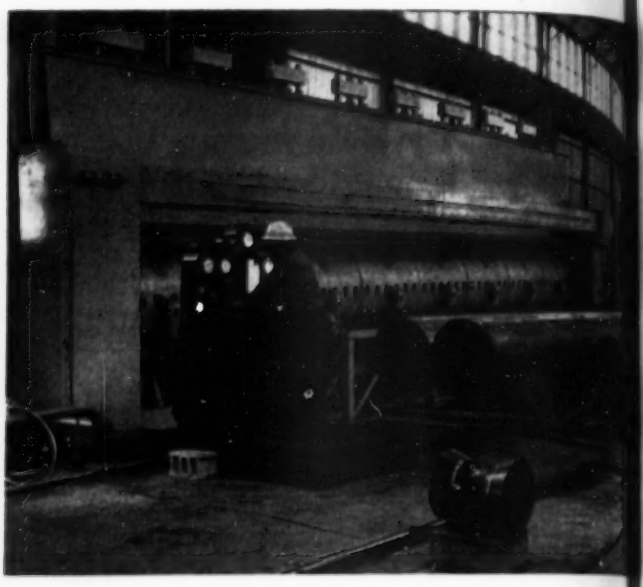
This machine simultaneously planes and trues the edges of steel plate in the Utah pipe mill. Edges are ready for welding when they emerge from this process.



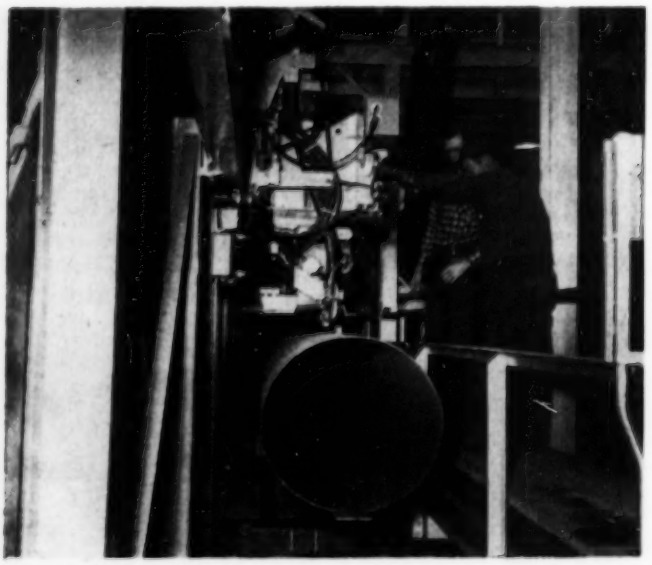
The 0.281 in. thick steel plate has been cold-formed into a "U-shape" by the 375-ton "U-ing" press at right-center in the picture. It is then conveyed to the "O-ing" press seen at far end of the U-ed plate.



One of the steps in manufacturing line pipe — the 750-ton "O-ing" press slowly presses down with its big dies, forcing the U-ed steel plate into a circular steel tube.



This expanding press cold-works the pipe under 5000-psig hydraulic pressure until it contacts the dies. The hydrostatic mill test is also made with this machine.



The submerged arc welding method (note that no sparks fly) is used to make the outside seams of the steel pipe sections. Five traveling welding machines are used for the outside seams.

The first truck shipment of expanded steel pipe leaves Consolidated Western's mill headed for Fish Northwest construction spreads on Pacific Northwest's pipeline in Colorado.

"The Scenic Inch" PART 3

THE CONSTRUCTION SPREADS

After visiting the pipe manufacturers' facilities, our tour of the Pacific Northwest pipeline took us to Green River, Wyo., since all the spreads active at the time of the visit were working south of this point. An Associated Pipe Line Contractors Inc. spread—spread No. 5—was working between two forks of the Green river just inside the Utah border. The terrain at this schedule is a mixture of the rolling plains of southwestern Wyoming combined with the Alpine-like mountain ranges of Utah. Associated's spread had made good progress with the pipeline in the relatively easy country working south from the junction with Colorado Interstate Gas Co.'s lateral that ties in with the Pacific Northwest line southwest of the town of Green River, Wyo. Pacific's line has been laid to both banks of both crossings of the Green river forks, and the extremely rugged Daggett mountains were about to be penetrated. Mt. Lena, 9722 ft, is the summit point of this range. The ROW of the line will follow high valleys and mesas through this range over a route that will be high, but in tolerable terrain if other spreads on the line are considered. Pipe stringing in these mountains will be rugged. On most other pipelines, this spread would be considered extremely rough—on Pacific Northwest's line, it is just another rough one. The north end of this spread marks the terminus of the 26-in. OD pipe.

The 26-in. pipe for Spread 5 was transported from Consolidated Western's Utah mill to Green River by rail. Also, 22-in. OD pipe for Spread 6 is coming into this point. At Green River, Parkhill Truck Co., Tulsa, is unloading the pipe from the railroad cars and racking it in stockpile for Spread 6 that will work north from the terminal point of the 26-in. Parkhill unloaded and stockpiled the 20 odd miles of 26-in. for Spread 5 at the same point of operation; it also trucked this 26-in. OD pipe to a second pipe stockpile near the Green river forks crossings. At this secondary stockpile, J. O. Willett was picking the pipe up and stringing it for the Associated spread.

The pipe-stringing trucks had to cross a ferry built and operated by Associated to get pipe, material, men, and equipment into about 13 miles of the spread near Manila, Utah, between the two forks of the Green river. The installation of the ferry saved about 80 miles of mountainous haul and, since available ferrying equipment could not carry the heavy and long equipment needed on a pipeline spread, it was necessary for Associated to build its own.

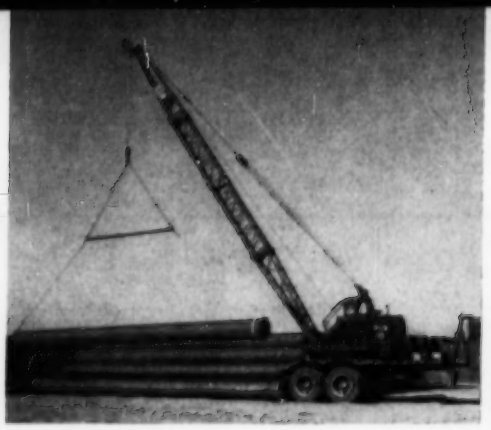
Five Flexifloats pontoons were interlocked together to form the ferry that has a capacity of 140,000 lb, and a ramp unit was attached to each end. A 16-hp engine furnishes power to a double-drum winch that powers the ferry along a guide cable that is tower hung from shore to shore at the 400-ft crossing site. The patented Flexifloats, a product of Robishaw Engineering, Houston, are designed for highway portability, so that when the ferry is no longer needed at a particular site, it can be sectionalized on trucks to form a load that complies with legal dimensions and weights for loads, and moved to another working site. Associated's ferry near Manila can make a trip in about four minutes and handles a tractor and trailer loaded with five 40-ft joints of 77.25 lb/ft pipe with ease.

This territory contains exposed strata and outcroppings that make it a paradise for the geologists, but it does not warrant this admiration by pipeliners. It is dusty hot, and the going will get rougher up in the mountains.

Spread 4, R. H. Fulton & Co., Lubbock, was working through the summit of Douglas pass, Colo., between Grand Junction and Rangely. Pipe for this spread's stockpile at Rangely was being trucked from the Utah mill by Parkhill Truck. Parkhill had a problem on its hands this summer as the roads between Provo and Rangely are not only hazardous for heavily loaded pole-trailers, but the operation had to pulled off when the tourist traffic, in an area that caters to this business, was in its fullest development. To keep these operations safe and to do a good public relations job

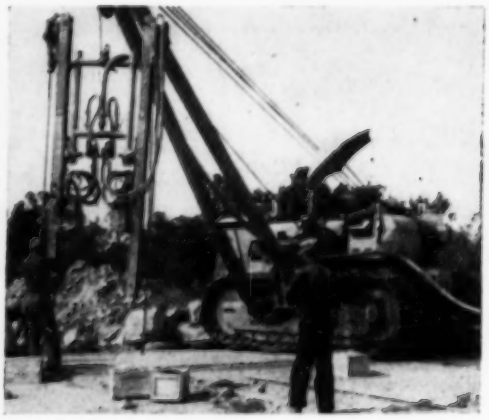
LATEST "BOX-SCORE" OF CONSTRUCTION PROGRESS

	Completed in 30 Days Ending Aug. 31 (Miles)	Completed Between Aug. 31 and Sept. 18 (Miles)
Schedule 1, River Construction Corp.		
Clearing and grading	18	
Pipe installed	24	53.83
Clean-up	12	
Schedule 2, River Construction Corp.		
Clearing and grading	18	
Pipe installed	9	25.45
Schedule 3, R. H. Fulton & Co.		
Clearing and grading	40	
Pipe installed	19	38.83
Clean-up	12	
Schedule 4. R. H. Fulton & Co.		
Clearing and grading	19	
Pipe installed	23	41.67
Clean-up	10	
Schedule 5. Associated Pipe Line Contractors Inc.		
Clearing and grading	5	
Pipe installed	13	44.05
Clean-up	29	
Schedule 6, Curtis Construction Co. (started Aug. 19)		
Clearing and grading	8	
Schedule 26, Curtis Construction Co.		
Clearing and grading	32	
Pipe installed	41	50.95 (Completed)
Schedule 27, R. H. Fulton & Co. (started Aug. 31)		
Clearing and grading	2	

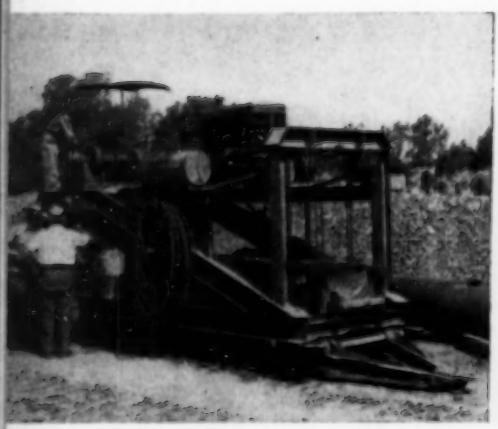


Pipe stringing truck (left) crosses fork of the Green River near Wyoming-Colorado border on pontoon ferry. Rangely, Colo. pipe stockpile (middle) for Spread 4 working through Douglas pass. A backhoe (right) has just topped the crest of Douglas pass and is making trench down the northern slope. This machine was instrumental in digging the trench up the southern slope to, and over the crest.

The rock gang (left) on Spread 4 uses a twin wagon drill and (middle) large air compressor being used to drill shot holes for blasting rock that will be mucked out with a backhoe, high in Douglas pass. Lowering-in on Spread 4 . . . pipeliners (right) check to see if the pipe fits.



Though most of Spread 1 that has been worked so far is pretty good pipelining country, rock turns up and has to be taken care of in the usual manner. Trenching on Fish Northwest's Spread No. 1 (right) runs into rougher work.



Bending crew (left) uses an uplift bender; here, Fish Northwest's inspector talks it over with the benders. Internal line-up clamp (middle) being positioned for the next tack weld. The firing line welders at work under a bright, hot Colorado sun (right).

GLASFAB HANDWRAP
Twinsburg-Miller Corp.

COROMAT
Glass Underground Pipe Wrap
Owens-Corning Fiberglas Corp.

OUTER WRAP
Kerr-McGee Oil Industries Inc.

ASBESTOS FELT
Keystone Roofing Mfg. Co.

Above . . . another snapshot for the Midwestern album of successful pipelines. Two products on this one . . . ASBESTOS FELT from Keystone Roofing Manufacturing Co. and COROMAT underground glass pipe wrap from Owens-Corning.

Each of the Midwestern distributed products at the left is designed for a specific purpose, but they stand together to offer complete corrosion protection to any above or below ground pipeline.

Ask the men who worked this line . . . ask about mileage . . . ask about ease of handling . . . and particularly ask about the Midwestern service that brought both men and materials to the line when needed.

For product, price and delivery information on these and others in Midwestern's complete pipeline materials stock, write . . .

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TAPECOAT-X METHOD
(applying 30 feet of TAPECOAT-X)
With the new Xtra thickness of coal tar, effective protection is assured by using a single-wrap in spiral form, with an overlap of only ½".

USUAL METHOD
(applying 30 feet of regular tape)
For effective coverage by the usual double-wrap method, it is necessary to overlap the tape slightly more than half its width.

See how the Xtra thickness of coal tar built into TAPECOAT-X provides extra protection per foot of tape. This extra thickness of coal tar, made possible by a new exclusive process, permits a single-wrap application that can be applied faster and over a greater area for savings in labor, material, time and money.

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Scenic Inch... Drivers observe safe driving practices

for Parkhill in compliance with their own and Fish Northwest policies, Parkhill hired local deputy sheriffs to patrol the routes and bring dangerous practices to the attention of the drivers in the form of a company fine system. This system is actually not a fine at all, but rather a loss of bonus credit. In addition, Jim Berg, Parkhill's safety director, was brought into the area with his bright, completely white Oldsmobile to direct the safety program for Parkhill's part of the Fish Northwest job and to patrol the roads as needed. His car is equipped for first aid and other emergency tasks, and is certainly the bright spot in the automobile world out in that part of the country.

Parkhill unloads the pipe at Rangely and stockpiles it with a P & H Mity-Mite truck crane mounted on a White diesel truck. The trucks operating from Provo to Rangely were supplied by Jess Edwards, Corpus Christie, Texas, who splits the contract with Parkhill, but Parkhill has the over-all administration and direction of the pipe stockpiling operation. M. J. Mackie, general superintendent for Parkhill on the stockpiling job in conjunction with Jess Edwards, reported that pipe was being delivered to the Rangely stockpile at a rate of a mile per day and was going out to Fulton's Spread 4 at 3600 ft per day.

The schedule through Douglas pass is rugged pipelining, but R. H. Fulton's spread is making it look easy. It is working north and is stringing its own pipe from Rangely stockpile south to the spread. At the time of our visit, the spread was strung out about 40 miles from the right-of-way gang to the clean-up crew. The only road through the pass and the mountain range is an unimproved, native-materials track that is single-lane in most of the higher elevations. The spread gang was living in Grand Junction and being transported to and from the spread in buses. Inaccessibility, however, was but one of the obstacles. The elevation makes working conditions uncomfortable, there is enough rock to keep the rock crew plenty busy, slopes of grades are severe, and there is little rain, so dust is bad enough to make some pipeliners

wear respirators. This illustrates that conditions are pretty rough. Roots, rock, and caliche at high altitudes make this the generally considered toughest spread on the line.

Most heavy equipment moves along the right-of-way with the aid of crawler tractors and on the more pronounced slopes nearly everything is hung on the side of the hills with from one to four cats. A Bucyrus-Erie backhoe dug the trench up the southern slope (15° to 45°) of Douglas pass with the aid of tractors to hold it while the ditch was made. It had just reached the summit and was on its way down the northern slope at the time of our visit. The right-of-way "brush gang" was working with the clearing crews some seven miles north of the summit. Brush was not too much of a problem where the eight bulldozers of the clearing section prepared the ROW and built the contractor's road. However, boulders were presenting a problem to the rock gang as it worked five miles from the summit. They were using twin wagon-drills, cradled by a sideboom tractor and fed air from a Gardner-Denver portable air compressor, for drilling shot-holes prior to blasting. Needless to say, the rock gang was using powder in quantity and had their work coming along fine.

The trenching crews were, as previously stated, using a backhoe to open up the trench behind the rock gang. Two Cleveland 320 trenchers were also in use on the Douglas pass work. They were making good time in more conventional stretches of the line. The amount of blasting required was making the trench walls rather jagged along the sides and on the bottom; therefore, the Fulton Spread 4 was putting a minimum of 6 in. of padding into the trench before lowering-in.

In country of this sort, bends are made very frequently. One would wonder on observation if any of the joints went in straight. This gang was using a Crutcher-Rolfs-Cummins uplift type bender high in the Douglas pass area. Benders reported that they were having a little trouble with bends in this relatively thin-walled (0.281-in.) pipe, but the over-all bending operation was very successful. Actually, when proper care was taken, the cold bends were very satisfactory under standard conditions. The bending crew was about two miles behind the ditch gang on the south slope of the pass.

R. H. Fulton is stringing its own pipe on Spread 4. It was using eight

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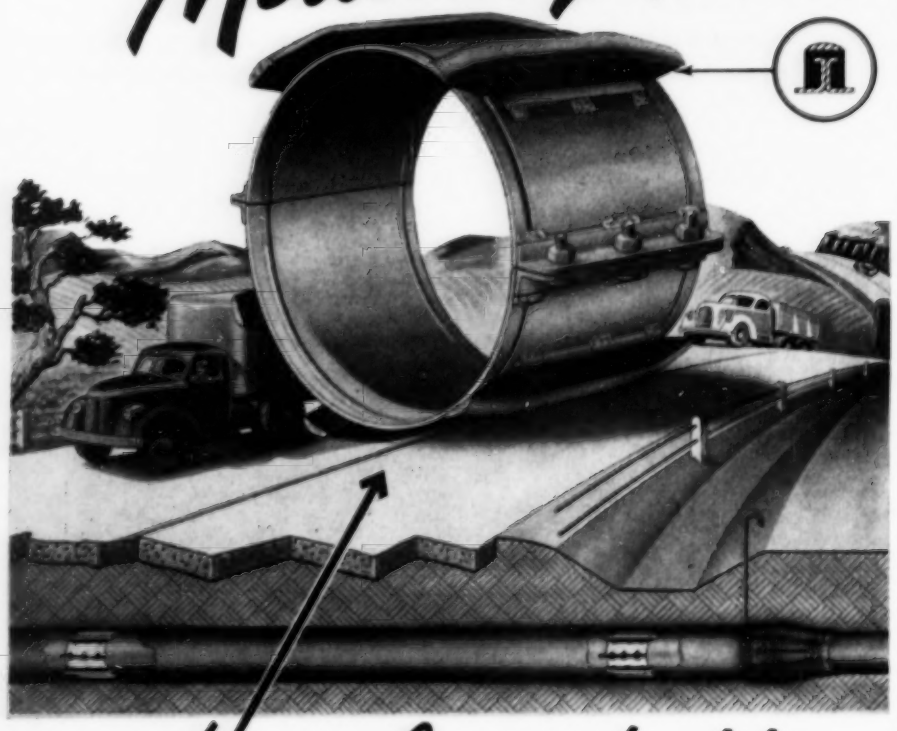

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Extra wide bands are ribbed ½" from the edge, eliminating the necessity of using rubber lining since the ribs prevent cold flow of the pipe wrap. Rubber liners can be furnished if desired.

The end seals are made of neoprene, affording long life even in contact with moisture and soil chemicals. The entire Seal is banded with stainless steel bands and clips. Seals are furnished solid or with pressure type zippers which are particularly desirable for repairing existing installations.

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LOS ANGELES TULSA ODESSA

pole-trailer trucks to bring in 26-in. OD pipe from the Rangely pipe stockpile north of where the spread was working. It was using a D-7 Caterpillar tractor with a Trackson sideboom to unload and space the pipe along the right-of-way. They were ahead of the ditching by a mile or so, but well behind the rock gang. It was not unusual to see a crawler tractor helping the long pole-trailer trucks get the pipe to the right-of-way.

The pipe gang was about three miles behind the benders, with the tack rig up front. An International Harvester TD-18 was pulling the tack rig, which had three 300-amp Lincoln welders for making the stringer bead for the tack weld. Two Caterpillar D-7's were being used for pipe line-up with this crew. The hot-pass welders used four 250-amp Lincoln welders and the firing-line welders were using 250-amp Lincolns. A Caterpiller D-2 was handling the welding generators. Industrial X-Ray Engineers (Seattle) was doing the weld inspection on this spread.

Coating operations were about eight miles behind the ditching crews. The forward section was using a D-8 to cradle for an M. J. Crose line-traveling cleaning and priming machine. The dope gang was close behind with two D-8's, two D-7's, an M. J. Crose coating and wrapping machine, and four Littleford 23-bbl dope pots.

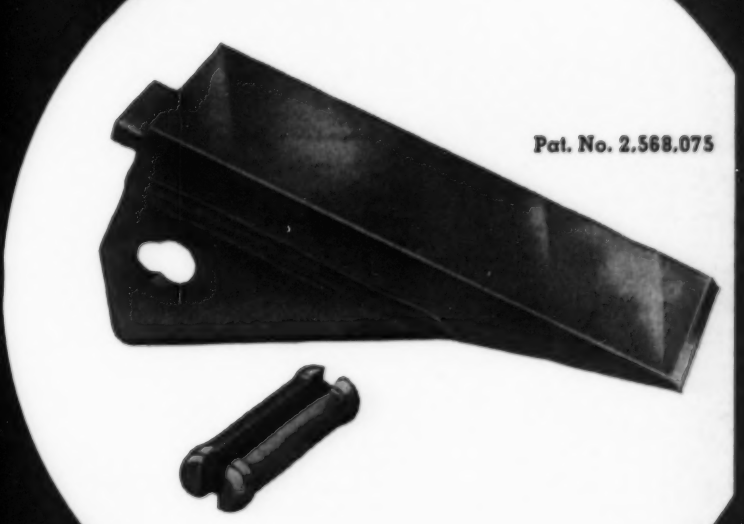
The lowering-in, tie-in, backfill, and clean-up gangs were close behind and making good progress for the kind of country they were pipelining in. The lowering-in operation was particularly intricate due to the grades involved and the great number of bends that were necessary to make the pipe fit the trench.

The spread superintendent explained that in mountain work a spread can really get "spread out" as was the case with Spread 4. He was starting a movement to close the spread somewhat when we left. The Douglas pass area is one that is a measure of men—Fulton's crew seemed to be used to mountains and were making pipeline at a rate of about 3000 to 3600 ft per day.

River Construction Corp. had its Spread 1 working on Schedule 1 near Cortez, Colo. This country is somewhat easier than that previously described, but at the time of our visit they had about run out of easy terrain and were starting to encounter the mountainous area as they progressed south toward Ignacio, Colo. As one pipeliner termed

Teeth that really dig

Pat. No. 2124230
and Pat. Pending



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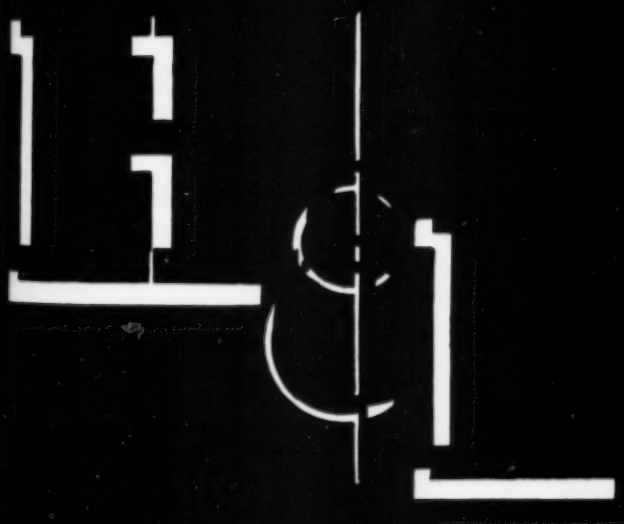

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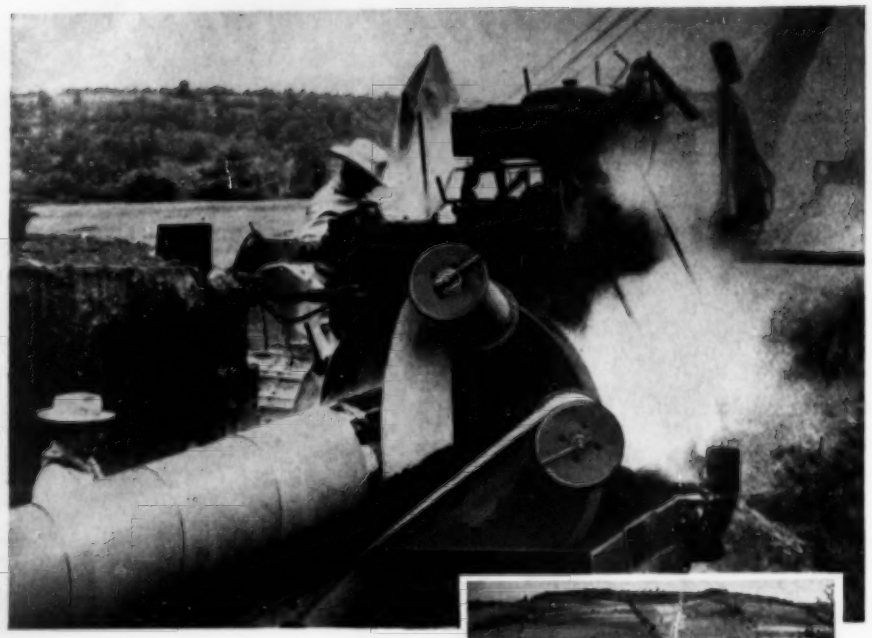

Wrapping the Tennessee Gas Transmission Company's new extension to serve the Greater New York and northern New Jersey areas. Note how Blue Flag permits quick bleed-through of the enamel.

"Holidays" averaged fewer than 3 per day with Blue Flag Pipe Wrap

Blue Flag almost eliminated "holidays" on Tennessee Gas Transmission Company's new 250-mile, 24-inch line, over rough ground in eastern Pennsylvania.

The dope gang reported an average of fewer than 3 "holidays" per day—unusually low for such difficult terrain.

The fine glass fibers in Blue Flag Pipe Wrap are made of highly inert glass. They are formed into a strong, uniformly porous mat which permits quick bleed-through of hot enamel and holds "holidays" to a minimum.

Pipeline companies find that Blue Flag increases the strength of the enamel coating, gives it exceptional resistance to cracking, and helps protect the line against corrosion.

Like Tennessee Gas, you can add years to the service life of your pipeline with Blue Flag Pipe Wrap, safeguard your large original investment for a small fraction of the entire cost. It's available from strategically located warehouses of Blue Flag distributors.

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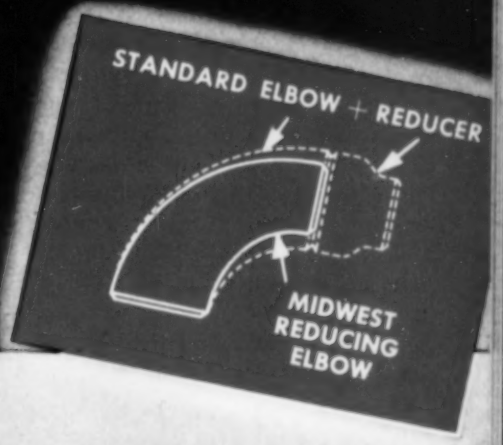
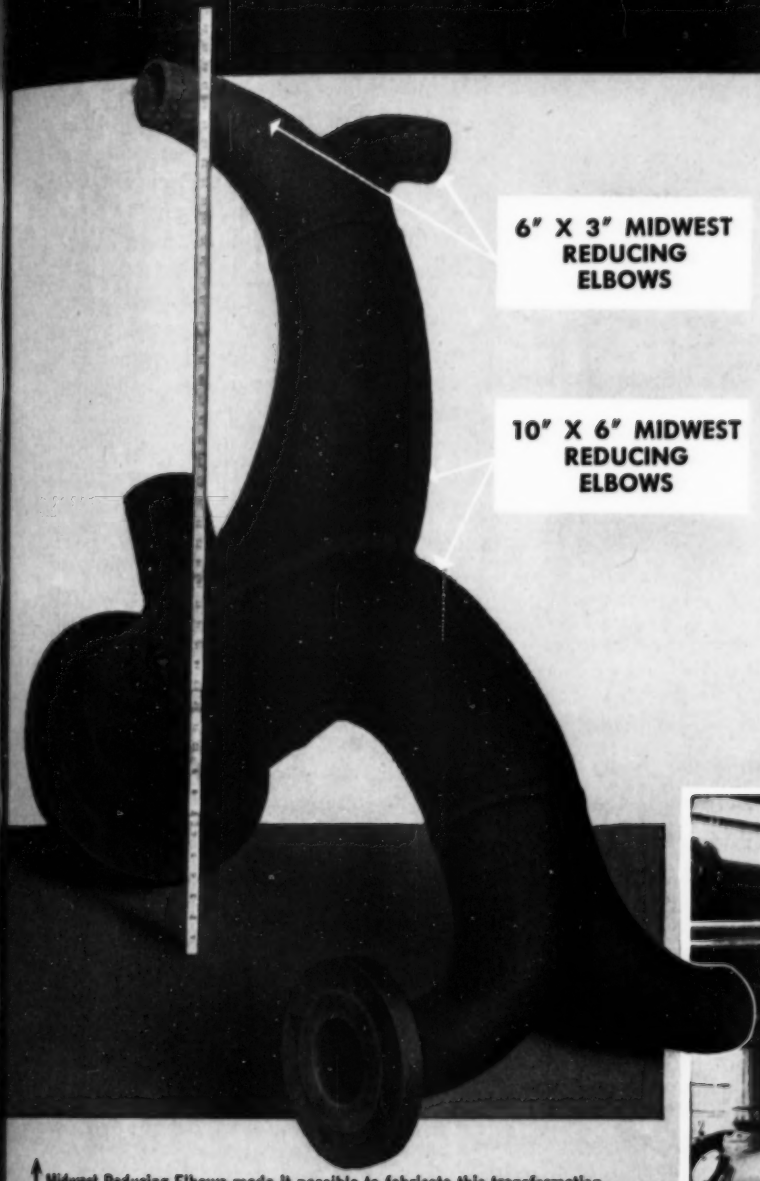
it, "friendships is about to cease." The right-of-way cuts through an area near Dove Creek and Cahone (both in Colorado) that is locally proclaimed to be the Pinto Bean Capital of the World. No doubt but what it is—all the pipeliners can see for miles is pinto beans. Although this may seem in a jocular vein, it illustrates a problem that was encountered when acquiring right-of-way, because the pinto bean represents a valuable and, to some elements, a staple crop. Naturally, this sandy, arid, productive land has value based on the economy of its yield. Right-of-way is expensive, but the problem goes much further than that. The construction must be accomplished with a minimum of crop damage and the clean-up job has to be good. Fish Northwest has considered these factors and is making friends with the farmers in this area as the line goes through. Fish Northwest and River Construction have had to "eat" a few pinto beans, but these have been equitably paid for and the clean-up job on this spread has been excellent. The contractor cooperates to the fullest extent in the solution of this problem. River Construction even has a man patrolling the spread in a jeep to keep the fences up as the work progresses. While we were with him, River's spread superintendent, Vernon Gayhart, did some patrolling on the fence builder, so the over-all policy of being neighborly with the landowners has been well carried out.

On this southern part of the line, the 26-in. OD pipe is railroaded from the Utah mill to a central stockpile at Thompson, Utah. Parkhill Truck unloads the pipe at that point and stockpiles it for Spreads 1, 2, and 3. Then, in coordination with the contractors' needs, the pipe is loaded on Parkhill's trucks at Thompson and trucked to smaller pipe stockpiles close to the right-of-way of the pipeline. There, the contractors' stringing trucks pick it up and string it.

The stockpile for Spread 1 was at Cahone, and for Spread 2 (another River Construction spread) pipe was being racked at Dove Creek, Colo. The route from Thompson to Cahone and Dove Creek is anything but ideal for heavy hauling. Along this route we ran into Jim Berg and his white Oldsmobile carrying out Parkhill's safety patrol. How the drivers get those long pole-trailers with nine joints of the 26-in. pipe over the narrow, twisting, up-and-down roads with the safety that

Better Piping at a Better Price by Using MIDWEST REDUCING ELBOWS

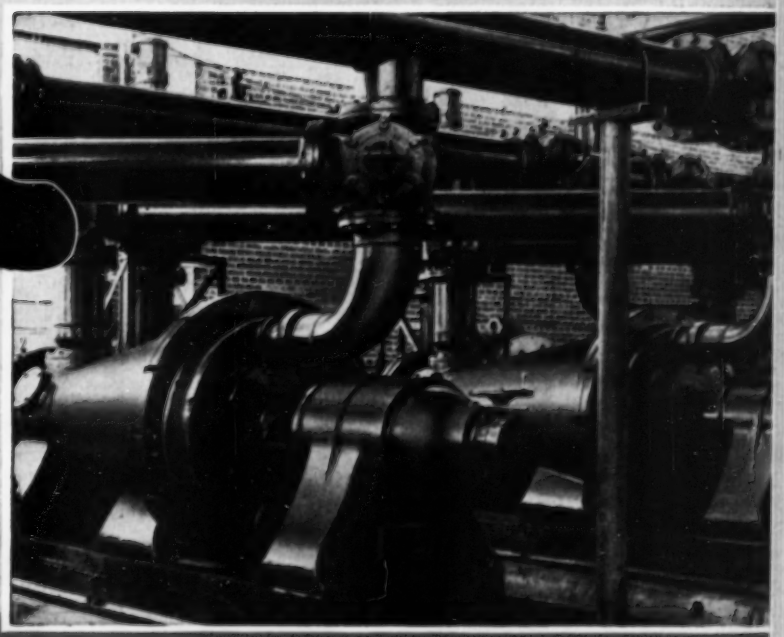




The Midwest Reducing Elbow offers important advantages in both piping design and piping cost. It needs only two welds instead of the three required by a standard elbow and a reducer (see sketch above). There is also a saving in layout time. Turbulence and pressure drop are reduced by the gradual taper . . . less space is needed . . . insulation is easier . . . and piping appearance is improved.

Only Midwest Reducing Elbows are available from stock in sizes to 16" . . . larger on special order. They have the same dimensional accuracy, uniformity of wall thickness, exact included angle and true center-to-end dimensions of Midwest Straight Elbows. For further information, ask for Catalog 54.

Midwest Reducing Elbows made it possible to fabricate this transformation piece for a boiler feed suction line so that it could be installed in the limited space available and still get the benefit of streamline flow. There was also a cost saving in comparison with a less efficient and bulky assembly made with straight tees, ells and reducers.



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they do, is beyond us—but they do it every day. At the Cahone pipe stockpile, they use the same model 1014 Unit crane on a Crane Carrier Corp. chassis that they unload the pipe with to pick up the pole-trailer and piggyback it on the tractor for the return trip. This makes for safe operation on the empty run and reflects Parkhill's part in the Fish Northwest policy of living with the people along the pipeline, and the tourists, in a fair and safe manner.

River Construction strings the pipe on its spread. The spread make-up is fairly standard and because of the favorable area they were in at the time, the crews were pretty well bunched up. They were having some trouble with rock and will probably hit more rock as they get into the less desirable pipeline country. It was hot and dusty on this spread, too.

The ditching gang was using Cleveland 320's, a Link Belt Speeder backhoe, and a Buckeye ditcher with a Caterpillar 13000 engine. All of this equipment was equipped with H & L teeth and was not having too much trouble maintaining the ditch at Fish Northwest's specified dimensions of 42 in. wide by 56 in. deep; although, they had to call on the wagon drills and dynamite in places.

The coating and wrapping crews were using a Crutcher-Rolfs-Cummins cleaning and priming machine, and a Perrault coating and wrapping machine to produce a good coating job. Hand repairs with the "granny rag" were few and the primer was drying extremely fast in this area where the relative humidity must have been near zero. The fast-drying primer was picking up a minimum of natural dust along the right-of-way. The welders were using Lincoln generators and were dressing the welds with a Black & Decker Manufacturing Co. heavy-duty grinder powered by a Kohler engine-driven generator.

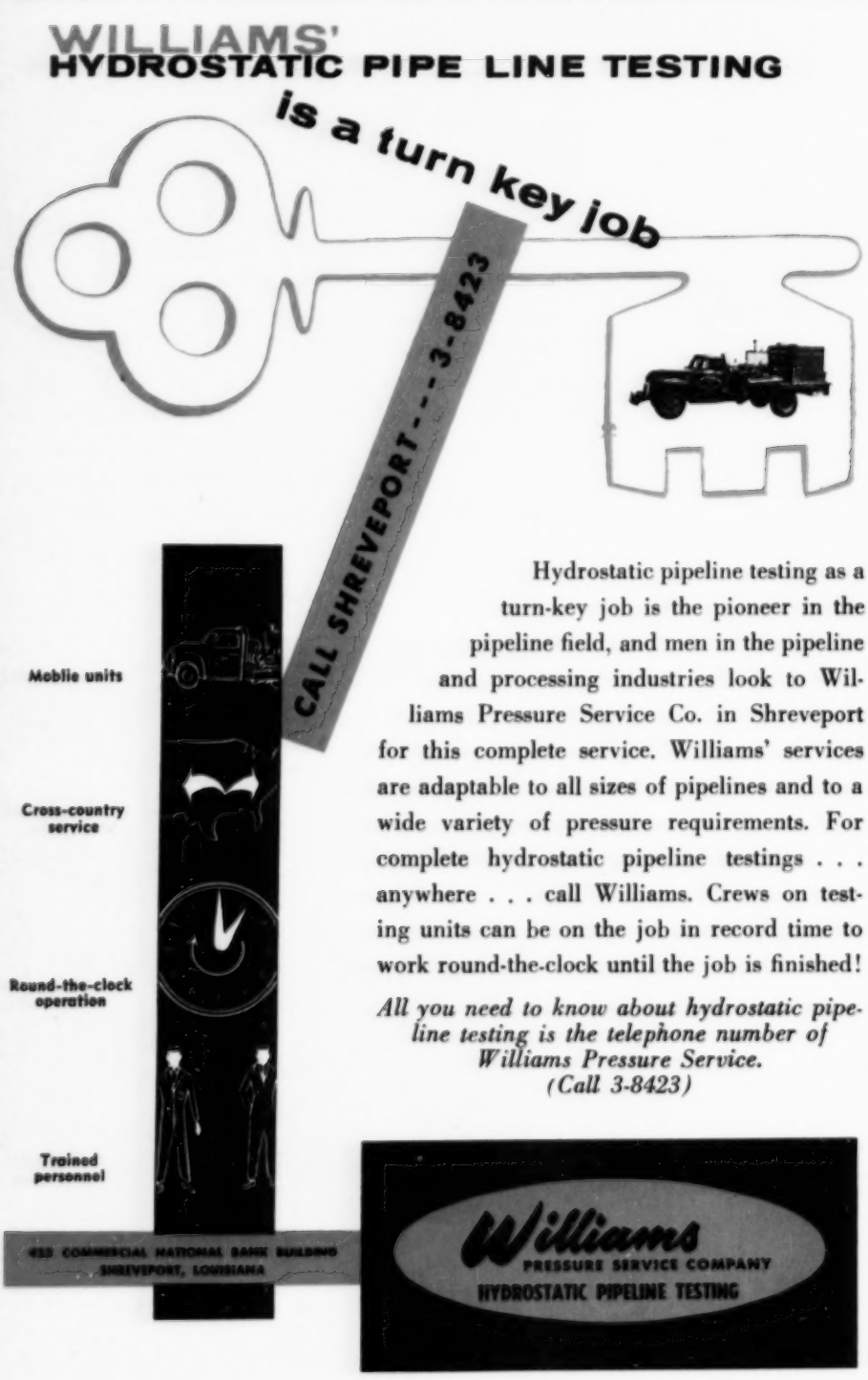
Inspection of the welds was being carried out in the field with truck units from Industrial X-Ray Engineers and holiday detection was being done with an S-P-1 holiday detector.

Pacific Northwest has a totally owned subsidiary company that is engaged in the exploration and drilling for oil and gas; but, in addition, this company has one other objective in mind—exploration into the possibility of uranium mining. On Spread 1, as in the case of the other spreads that will pass through favorable looking terrain, the uranium team is watching the pipeline ditch for signs of this mineral's ores with the aid of fully equipped jeeps.

The intense uranium activity in the area has not made Fish Northwest's survey permitting and right-of-way buying any easier.

Spread 1's clean-up operation has been described previously as excellent. New fences have been put in where old ones had to be removed and, in some cases, the right-of-way has been fenced at the fence line where there was no existing fence; but, as the farmers say, the heavy posts set by River Construction make good corner posts.

The rights-of-way were graded, terraced, and backfilled to the farmers' satisfaction. Then, debris was removed and the surface disked. Where necessary, erosion ditches and dikes have been constructed to maintain the worked over area. Most farmers reported that they would plow right on over the pipeline and plant their pinto beans and wheat. This means that the farmer does not lose any of his productive area and the planting will hold the topsoil and prevent washout of the backfill.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River Construction controls its key men and equipment on Spread 1 with VHF mobile radio. At the time we were there, the key Fish Northwest inspectors, engineers, etc., had General Electric mobile units in their cars and trucks so that they could be in communication with their own and the contractor's personnel through the contractor's frequency. This temporary base station and net speeds the work and efficiency of all concerned.

At the time of our visit to the Fish Northwest construction sites, the following progress had been made:

Schedule 1, River Construction Corp. 70.39 miles* 26-in. OD: clearing and grading, 29 miles; pipe strung, 27 miles; trenching, 19 miles; bending, laying, and welding, 17 miles; coating, 16 miles; lowering-in and backfilling, 15 miles; clean-up, 12 miles.

Schedule 2, River Construction Corp. 80.15 miles, 26-in. OD: clearing and grading, 17 miles; pipe strung, 1 mile; trenching, 6 miles. They want to open about 25 miles of trench before laying pipe as the soil is very rocky in this spread. They will not lose trench—it doesn't rain out there to speak of.

Schedule 3, R. H. Fulton & Co. 78.21 miles, 26-in. OD: clearing and grading, 6 miles.

Schedule 4, R. H. Fulton & Co. 90.82 miles, 26-in. OD: clearing and grading, 21 miles; pipe strung, 20 miles; trenching, 17 miles; bending, laying, and welding, 15 miles; coating, 15 miles; lowering-in and backfilling, 6 miles; clean-up, 6 miles.

Schedule 5, Associated Pipeline Contractors Inc., 73.71 miles, 26-in. OD: clearing and grading, 33 miles; pipe strung, 27 miles; trenching, 26 miles; bending, laying, and welding, 25 miles; coating, 24 miles; lowering-in and backfilling, 23 miles; clean-up, 5 miles.

Schedule 26, A. J. Curtis Construction Co., 51.00 miles, 16-in. OD: clearing and grading, 19 miles; pipe strung, 11 miles; trenching, 7 miles.

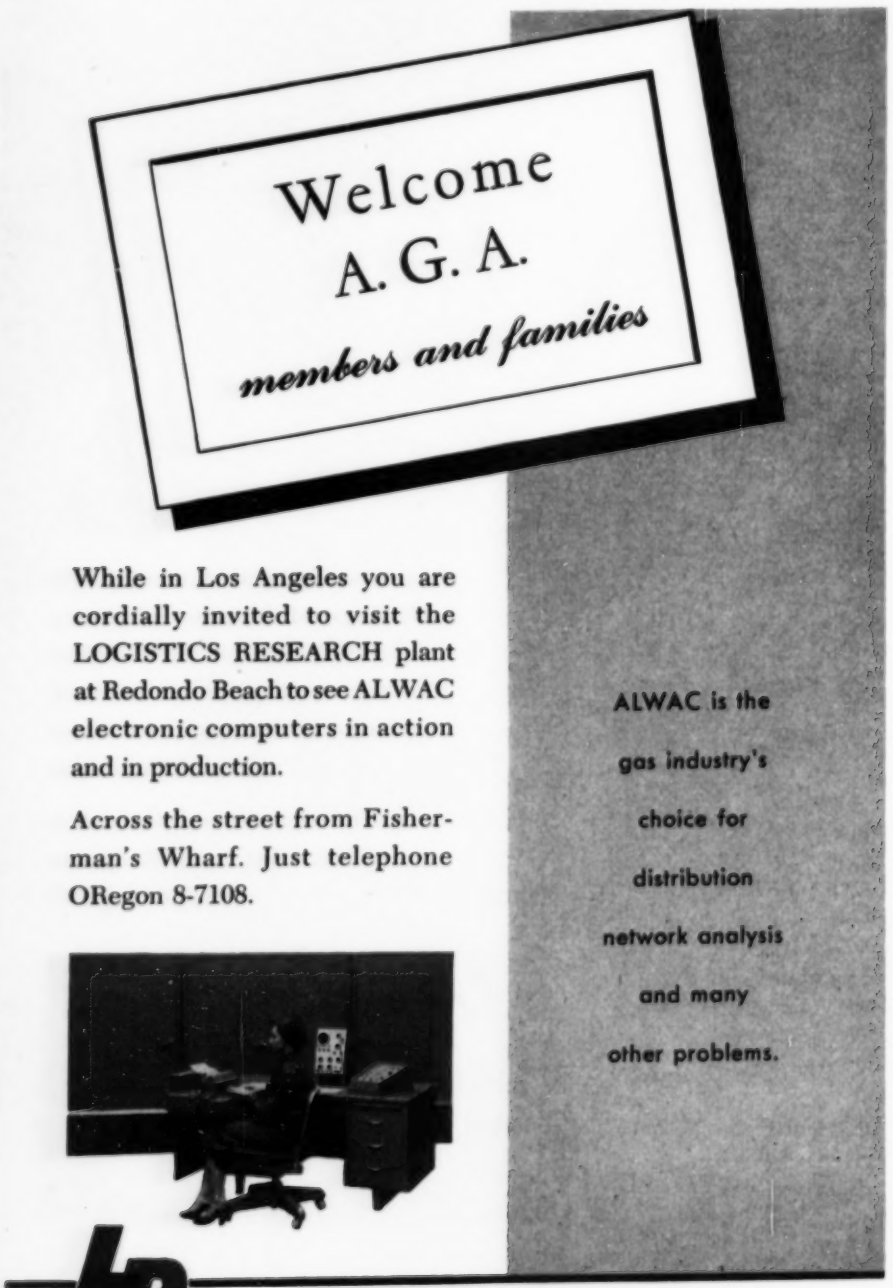
In recapitulation, these figures mean that in just 88 days following the closing of the financing of the project, Fish Northwest has:

(1) Permitted 1100 miles of ROW for surveying.
(2) Staked out 900 miles of ROW.
(3) Purchased 500 miles of ROW.
(4) Cleared and graded 125 miles.
(5) Strung more than 86 miles of pipe.
(6) Had 75 miles of trench opened.
(7) Bent, layed, and welded 57 miles of pipe.
(8) Coated and wrapped 55 miles of line.
(9) Lowered-in and backfilled 44 miles of pipeline.
(10) Cleaned up 23 miles of ROW.

It should be realized that while this issue of *GAS* was being printed still other progress was being made out on the line. Material was ordered and delivered, pipe was stockpiled in new locations as the progress of the spreads obsoleted previously used stockpiles, and design work continued in Fish Northwest and Fish Engineering offices.

So, "stand by" are the key words to the distribution companies and industries in the Pacific Northwest. They have shown remarkable patience to date, but the time of waiting is fast closing as the men and machinery out on the spreads cut through rock, desert, and mountains on their unerring path to this territory—the answer to some of your growing pains will soon be there—natural gas is at last just over the horizon. It will reach you on schedule. ■

*See footnote on p. 184.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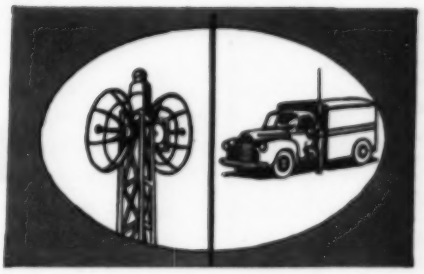


By FRANK CHAPMAN

TVA using facsimile over microwave circuit

FACSIMILE equipment is being used by the Tennessee Valley Authority over microwave in an operational application similar to that demonstrated by *GAS* magazine over one of the major cross country gas pipelines early in August. (See September *GAS* p 107.)

The two-way facsimile system is installed between the TVA control headquarters in the Power building in Chattanooga, Tenn., and Wilson dam at Muscle Shoals, Ala., 180 miles distant. Facsimile equipment used on the circuit is called the Electronic Messenger and is manufactured by Air Associates Inc. of Teterboro, N. J.

The system has greatly accelerated the flow of data necessary in the daily control of electric power, the control of floods and irrigation and other TVA matters. In particular the facsimile equipment is used to transmit the following three types of information: Daily power load requirements of TVA's 51 hydro and steam generating plants, service interruption notices (used when plant shutdown is required for equipment repair, customer's request and other reasons), and daily water inflow and outflow data along with reservoir elevations.

Accuracy of the control information is of utmost importance in preparing TVA's projected 24-hour operational schedules. Combinations of various information are entered on columnar forms approximately 13 in. by 17 in., which are transmitted by the Electronic Messenger at Chattanooga to a companion machine at Wilson dam. A monitor copy is simultaneously produced at the source as a record of the transmission. Receipt of these data is necessary for precise scheduling of power output from the system.

Comparison studies conducted by TVA dispatching personnel show that on a day in which 21 transmissions were made, total accumulated transmission time on the facsimile equipment took approximately 1.4 hours. It was estimated that if the same number of messages had been transmitted by teletype it would have required about 5.6 hours. Telephone dictation of the same material, with confirming "read back," would have taken a total of about 14 hours.

TVA operates the facsimile equipment over a broad-band microwave radio channel. The microwave system has five relay stations along the 180-mile distance between the two operational locations.

The Electronic Messenger is a single package transmitter-receiver slightly larger than a typewriter. Transmission is by the conventional photo cell system, while received copy is recorded electrolytically on chemically treated paper. The facsimile copy may be used as a master to produce extra copies by any diazo duplication process.

The equipment scans and records at a vertical definition of 100 lines per inch. Scanning rate varies according to the model. The high-speed model scans 3.3 linear in. or 28.1 sq in. per minute, while the slower speed model scans 1.65 linear or 14.0 sq in. per minute. The higher speed model operates at a frequency band of 1300 to 4500 cycles per second while the low speed model operates at 1050 to 2700 cps.

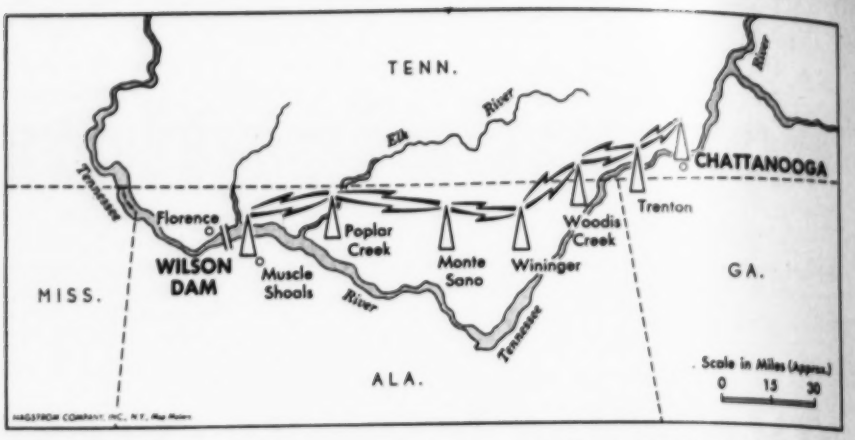
Copy for transmission may be up to 8½ by 14 in. Recording is continuous on a 100-ft roll of paper.

A pioneer in electronics, Air Associates Inc., manufacturer of the equip-

Operating room at TVA headquarters in Chattanooga, showing the Electronic Messenger that is linked by microwave with Wilson dam.

ment, has designed and manufactured many different types of electronic equipment for military and commercial use. These include radio ranges, special purpose receivers and transmitters, aircraft intercommunication systems and underwater telephone systems.

According to Casper M. Bower, general manager of Air Associates' Facsimile Equipment division, on the basis of the excellent performance of the equipment, TVA is investigating the possibility of using it to connect five other dispatching offices with the office of the chief load dispatcher at Chattanooga.



A map of TVA's 180-mile facsimile microwave system between Chattanooga and Wilson dam.

Several short-haul uses of the equipment are also under consideration where data flow is heavy and could be accelerated. One such possible application is the linkage between the several widely dispersed maintenance shops and the generating plants, all located in the Wilson dam area.

Gulf test of microwave propagation

The electrical engineering research laboratory of the University of Texas has completed an extensive series of microwave radio, meteorological and oceanographic measurements utilizing two oil drilling platforms in the Gulf of Mexico.

The project involved a basic research study of the manner in which water waves and low level wind, temperature and moisture variations affect the transmission of very short radio waves. Observations were made over the period from April 15 to May 4, 1955.

Radio signal strength measurements as a function of time and height were made at wave lengths of 5.3, 3.2, and 0.86 centimeters. A number of special transmitting and receiving antennas were used in order to resolve the radio energy into components traveling along the direct straight line path and the path involving reflection from the water surface.

Analysis of the data obtained will take many months. The results will shed new light on the theory of overwater microwave radio propogation and make possible the continuing improvement of microwave communication.

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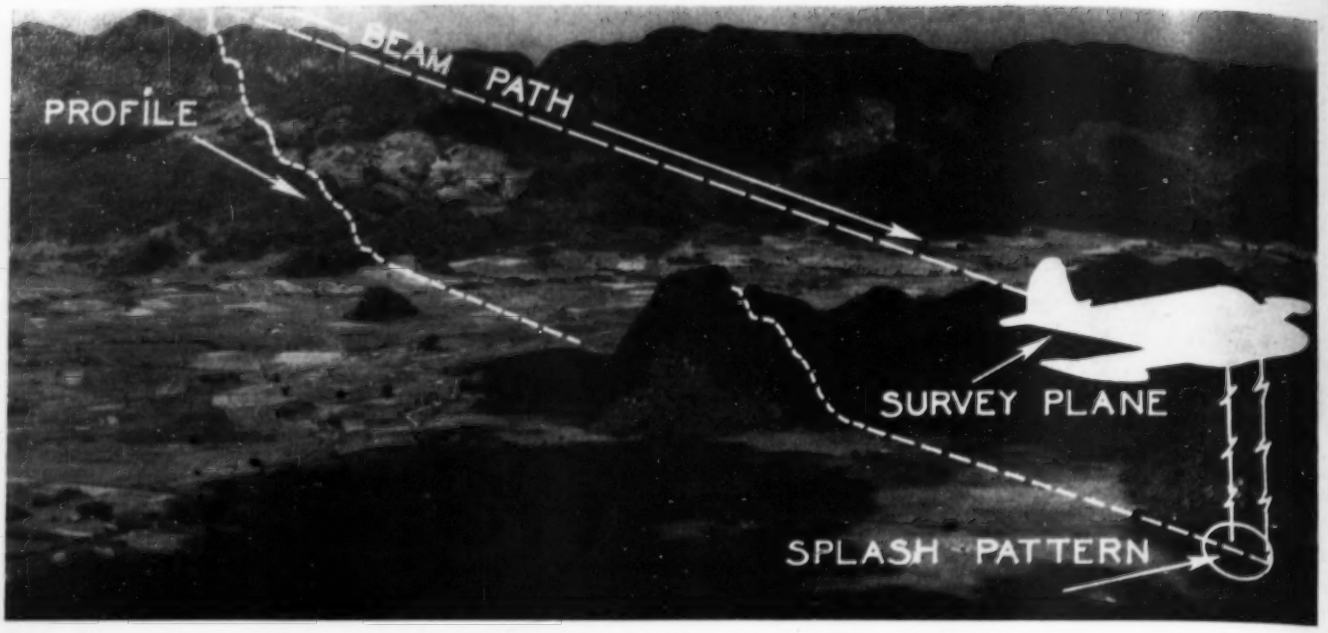

Fig. 1—A measured pulse system of radar probing continuously profiles the topography of a proposed microwave system as plane speeds along the microwave beam path at 120 mph. As indicated on the composite photo, radar reflection synchronized with altimeter reading results in data for computation of relationship between observation platform (airplane) elevation and mean sea level.

How radar is used to profile microwave communication paths

By **W. C. EDDY, President** • Television Associates of Indiana Inc., Michigan City, Ind.

The art of profiling microwave communication paths can range from a simple visual analysis coupled with a long shot guess, to a foot-by-foot study of the path by radar and photographic methods.

FEW surgeons would attempt a major operation without a preliminary study of X-ray pictures, nor would any but the most optimistic wildcatters set up drilling operations in an unexplored area. In the field of pipeline communications we find equivalents in the requirements for a preliminary survey before building a microwave system.

To the layman, the requirements of a satisfactory microwave system resolve into the question: "Can I be assured of reliable communication between points A and B?" To the design and operating engineer the accomplishment of such a specification is somewhat more complex, requiring a complete and detailed analysis of the proposed paths and the various topographic and refractive phenomena that may be encountered over this path.

All too often in the past, the brute force system of building an expensive network has been elected in lieu of adequate study of the path and the possible alternates, relying on the ability of the contractor to "fix up" the system after it has been built, rather than to predesign the facilities to meet the existent problems along the path.

The drawing of a blueprint, and the subsequent interpretation of the problem on paper, before the system is installed or contracted is generally referred to as "path profiling." The art of profiling can range from a simple visual analysis coupled with a long shot guess, to a foot-by-foot study of the path by radar and photographic methods.

Surprisingly, the costs, based on end results of any method of path survey other than the "by guess and by god" method, average out to about the same cost per mile when finally resolved into a complete and usable report.

There are several accepted methods of path analysis, any of which will, with proper interpretation, provide the basis of a working system. These techniques are:

1. The ground or walking survey.
2. The photogrammetric system.
3. The radar profiling technique.
4. Path test procedures such as explor-

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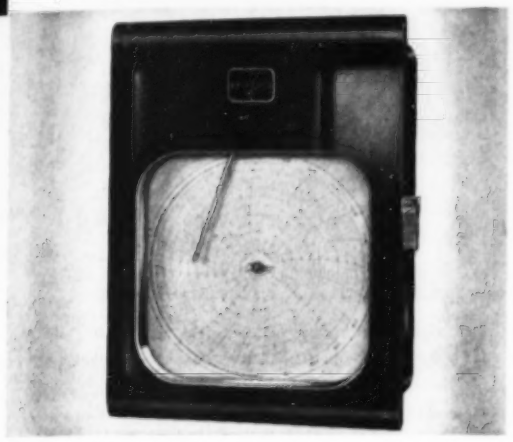
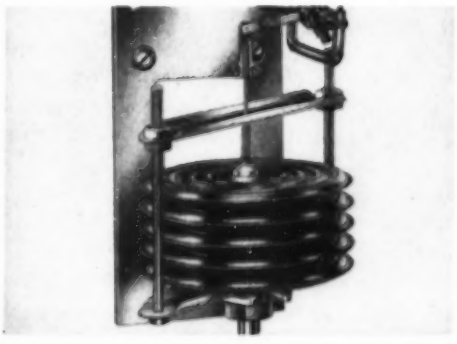
1 **Q.** Why are more Bristol Recording Gauges used than all others combined?



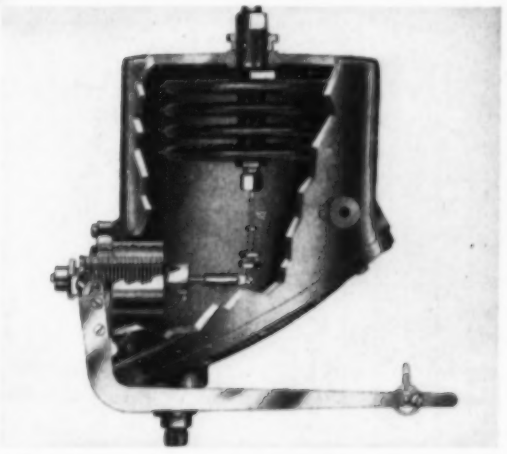
A. BRISTOL'S PRESSURE MEASURING ELEMENT, heart of the pressure gauge, is the big reason. Bristol Pressure Gauges, operating all over the world under all conditions – some in constant service for 20, 30, even 40 years – prove its accuracy, long life, and stability.

2 **Q.** What's the *right* measuring element for low pressure ranges?



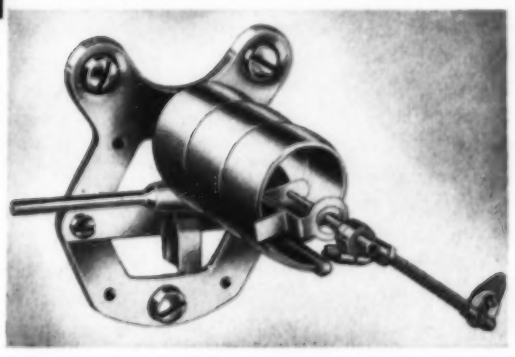
A. BRISTOL'S DIAPHRAGM MEASURING ELEMENT, for ranges from 0–2 in. water to 0–29.9 psi. Extremely high torque gives positive pen positioning across entire range. It's highly accurate, extremely stable. 250% inherent over-range protection.

3 **Q.** What's the *right* measuring element for absolute pressures?



A. BRISTOL'S SINGLE-BELLOWS TYPE ELEMENT. It measures ranges as low as 0–6mm mercury absolute and gives direct reading of pressure above absolute zero corrected for barometric variations – with far greater accuracy than ever before.

4 **Q.** For intermediate and high pressures?



A. CORRECT ANSWER here is either Bristol's *Type 316 stainless steel* or *non-ferrous alloy* helical measuring elements. They're designed for ranges from 0–30 psi all the way up to 0–10,000 psi. Withstand impact of rapid fluctuations, give *permanent* accuracy over a long period of service life.

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Radar profiling... The results of the ground survey are limited in their application to the problem

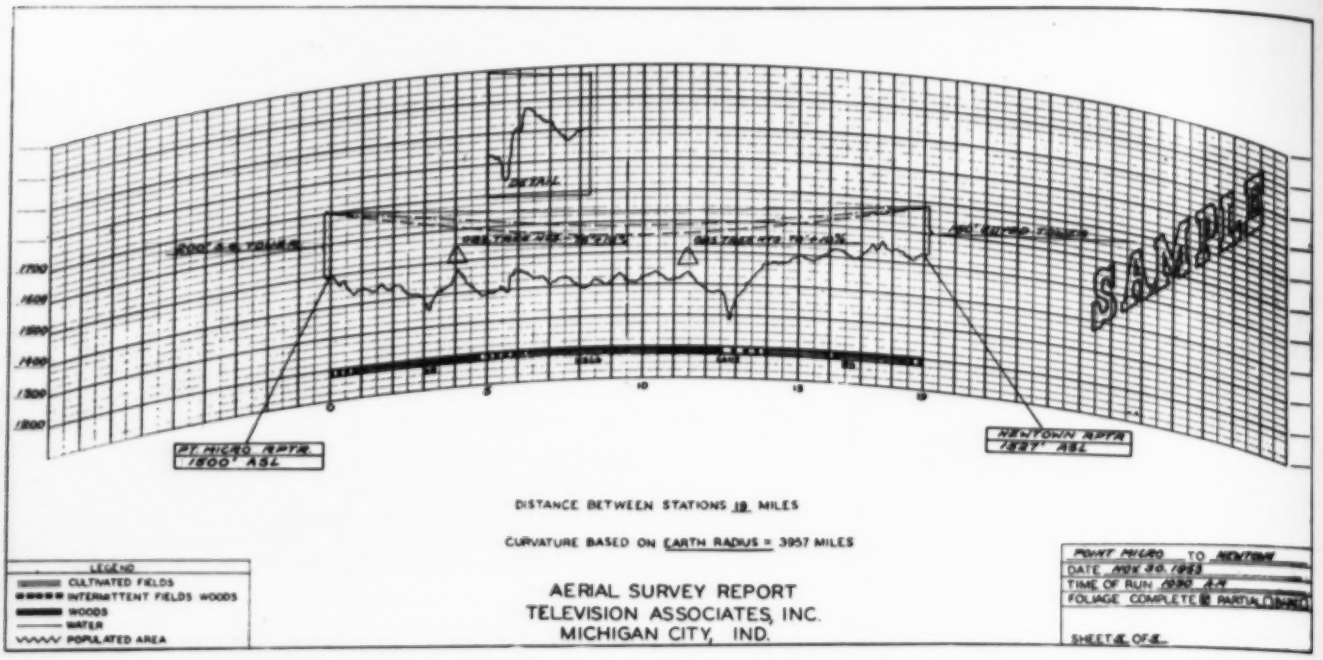

Fig. 5—Design engineer can determine clearance between ground level and the line-of-sight connecting two hypothetical tower sites from finalized graph as shown. Profile is adjusted to earth's curvature, so terminals of the curve coincide with altitudes for these sites developed from USGS bench marks.

atory transmissions and flashing lights.

5. The use of topographic maps.

Before describing in detail the various systems, let's look at the answers that any of the above techniques must develop. The basic requirements of a satisfactory microwave transmission path is to find a route that will provide an unobstructed line of sight between the two reflectors. This line of sight should be sufficiently removed, both vertically and horizontally, from the controlling obstruction to allow transmission of maximum signal energy from one point to the next.

This beam of energy will, in transiting the open space between the reflectors, be subject to refractive and defractive bending. These phenomena must also be considered in the design of the system. To collect such data the survey must be able to show:

1. An accurate profile of the ground between the two selected sites along the exact path to be transited by the signal.

2. An analysis of the atmospheric conditions, coupled with the terrain characteristics along the path, that may influence the bending of the signal beam.

3. Accurate determination of elevations at both sites as well as an accurate determination of the elevation of the various obstructions along the path.

These are the major requirements of any survey, be it from the ground or in the air. It is obvious that such data should relate only to the exact beam path if these data are to be used to determine the performance characteristics of the system.

Such a requirement would suggest that the exploration could best be conducted along the axis of the proposed beam path rather than above or below this imaginary line.

With these requirements in mind, let's review the various survey methods now considered acceptable.

Ground survey

In this technique, an engineering group will trace, insofar as practical, a straight path between the two sites, making elevation measurements as they proceed. Over flat or unobstructed terrain, this procedure can generally be accomplished without undue delays or expense, even though the demonstrated ability of a ground crew to follow an exact path may leave much to be desired. Over rough or heavily timbered areas, and in some cases across developed farm lands, the crew may find it impossible to follow such a path and, if this is the case will have to resort to sampling measurements in those spots that are accessible.

If the data collected by this crew are accurate and of sufficient detail to truly delineate the conditions along the path, and if the process of obtaining such data was not too time-consuming, the ground, or walking, survey will prove to be an economical method of assembling data. If, however, the data collected are so limited in scope that assumptions must be used in place of facts, or the data collected are from areas not directly on the beam path, the results of a ground survey are limited in their application to the problem. One of the criteria normally used in testing a path profile is to develop two separate and independent profiles, originating at opposite ends of the path. If these profiles coincide, the accuracy of the curve can be assumed. With a ground system such a cross check method may prove laborious, expensive and not too easily accomplished.

Further, ground survey methods disclose to the farmers in the neighborhood that land acquisition can be expected in the future, which, in many cases, has increased the land values of the desired sites. As outlined above, an accurate ground survey conducted by qualified personnel with good instrumentation and over accessible terrain can develop satisfactory data at a low cost. Complications along the path can

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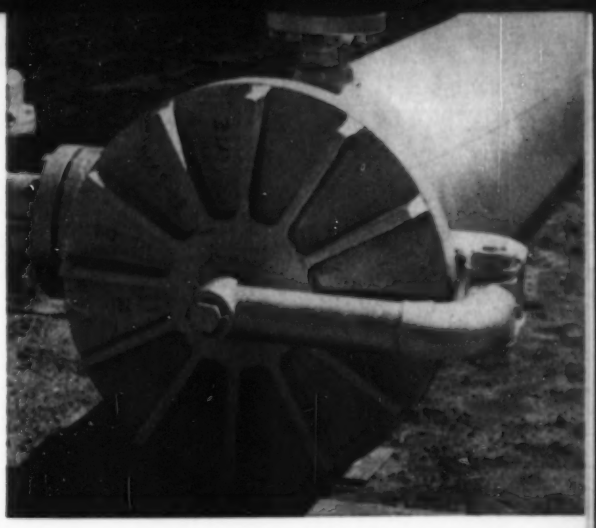

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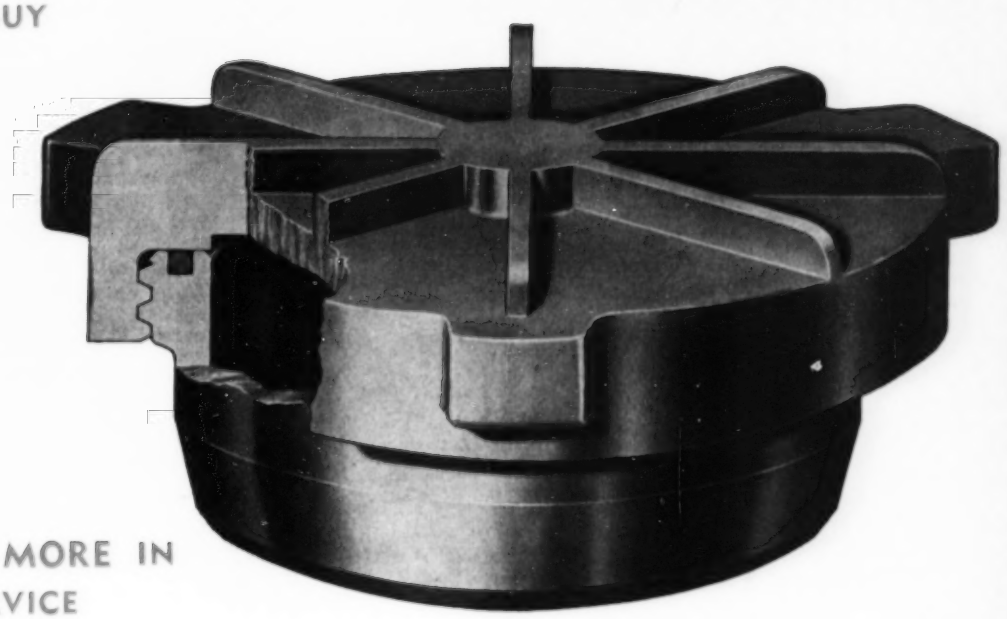

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. . . Radar profiling

easily increase the cost to that of the complete aerial system.

Photogrammetric system

This technique, developed during World War II, relates to a dimensional photographic study of a selected path and its later interpretation into a topographic chart. The accuracy of this system within the limits required by a microwave system is acceptable especially over terrain completely forested or cleared. The photographic phase is accomplished at relatively high altitudes and because of this fact requires satisfactory flying and photographic weather. Such conditions, however, are predicted only 10% of the time over typical sections of the United States, a factor that would indicate a time element that might rule out choice of this method. After having completed the aerial photographic phase, the strip maps are analyzed in a laboratory where the photographic material is resolved into the topographic profiles producing in the end not only a photographic strip map of a pre-selected path, but an accurate topographic chart as well.

In this method we find many excellent solutions to the problem of path determination. The accuracy is good, the resultant combined photograph and topochart gives excellent data as to the path arrangements and the elevations. Having been accomplished at high altitudes, no notice has been broadcast to the tenantry along the path that a survey was in progress.

Its faults lie primarily in the relative high cost per mile, in the delays that may be experienced in collecting data, as well as in the interpretive processes, and, lastly, in the fact that only one selected path has been covered even though that path may, after study, prove unusable. Such a survey requires ground substantiation to develop local weather characteristics and to fix reference bench marks used in orientating the elevations on the topographic sheets.

Use of topographic charts

Plotting a path from topographic charts is by far the most economical method of developing a profile, and where such charts are current and accurate, it is a system that will generally

Communications and radar equipment (above) installed in survey plane. Survey plane (right) showing radomes and tip tanks.

produce a dependable working path.

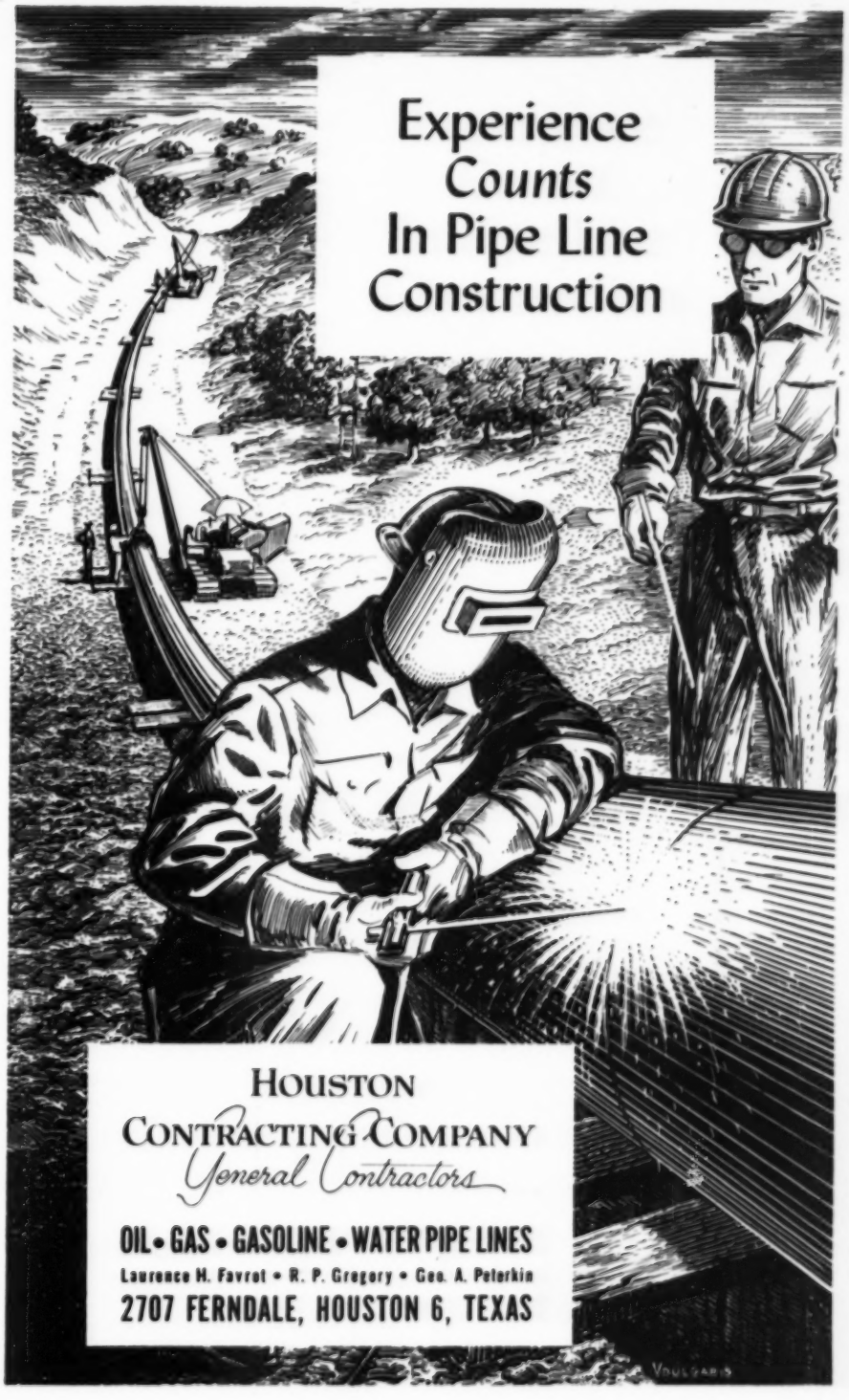
With such a profile developed and the potential obstruction evaluated, it is relatively simple to send ground crews in to substantiate the elevations and develop material on the surface conditions and weather at these points.

There is, however, one unhappy element in the use of topographic charts. Only an extremely small proportion of the world has been charted and these sections seldom lie in the areas where industry requires a network.

Radar profiling

Like the photogrammetric systems, the techniques of radar profiling were born in the latter years of World War II. Using specialized vertical radar coupled with highly accurate barometric devices, a plane flying along the axis of the proposed microwave beam can explore and record the ground beneath at speeds of 120 mph. From the vantage point provided by such a plane it is possible to not only traverse the exact beam path but to reverse the course and retrace the path, thus producing duplicate profiles as a cross check on accuracy. Several natural gas pipeline companies have utilized this method.

In charting the vertical displacement of the ground beneath the airplane, a measured pulse system of radar probing has been devised as the most practical method of measuring the vertical distance between the plane and the reflective surface beneath (the ground). Measurements are made in feet once each second as the survey ship traverses the proposed path. At the same instant in which the radar reflection spelling out vertical distance to



...Radar profiling

the ground beneath is received, a reading is taken of a pressure altimeter indicating the height of the observation platform above mean sea level. Thus we can, by subtraction, determine the height of the spot of land directly beneath the plane at the instant of measurement. While this theory is entirely logical, the practical accomplishment has required the development of special techniques before the practical results could be relied upon.

Photo taken from survey plane flying at beam altitude.

It is obvious to all who have flown in an airplane that except in still air the body of a plane tends to move upward and downward in much the same manner as a ship at sea. This variable platform then requires that a reading of the indicated altitude be logged each time we probe the ground. This required quick succession of many readings is tabulated photographically on motion picture film and later transferred to profile readings.

It is also a known fact that atmospheric pressure will vary widely in different localities and that the pressure-type altimeter will indicate readings above or below actual altitudes as the plane enters or passes through these barometric gradients. For this reason, an altimeter which has been properly set at "take off" may not, and probably will not, indicate true sea-level altitude once the plane has left the pressure area of calibration. It is necessary, then, to clear our problem of this possible error and be able to accurately set the pressure altimeter in the pressure area where the survey is to be made. This is accomplished by using laboratory-type electrical-delay-line equipment in the plane to accurately calibrate the radar to zero after the plane has been flying sufficient time to stabilize heat and voltage conditions in the electronic currents. With the radar known to be accurately adjusted and capable of reading exact vertical altitudes, the plane is then flown over some reference area of known altitude, such as a lake or an airport in the immediate vicinity of the proposed path. With the plane maintaining a constant vertical distance of 100 ft above this reference table by radar, the pressure altimeters are then set to read the height of the reference

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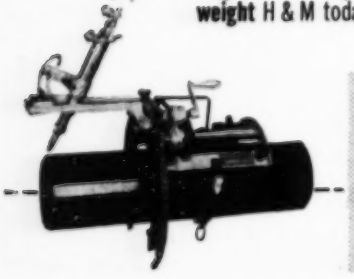

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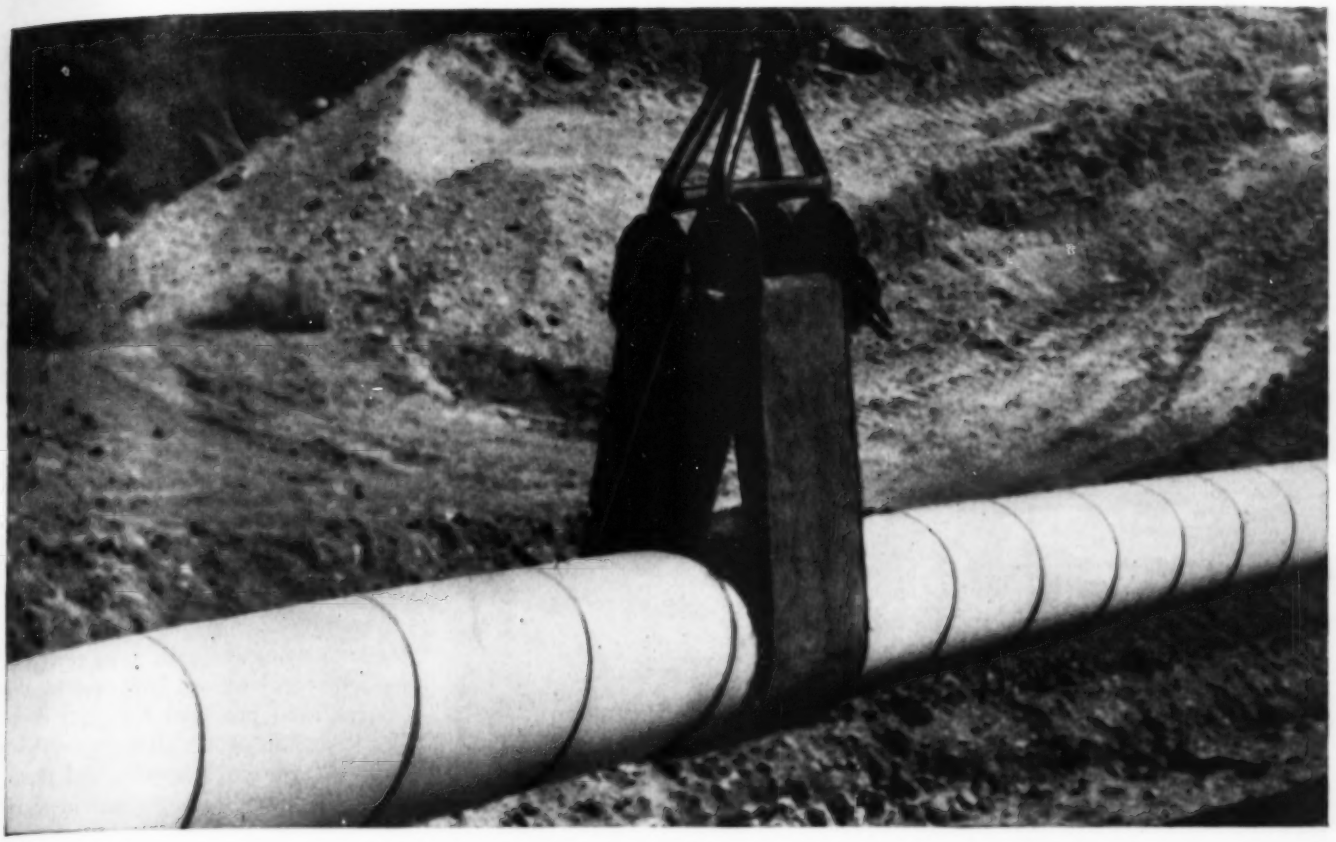

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Pipeline installations often represent multimillion-dollar investments. Dependable protection of that investment is of vital importance.

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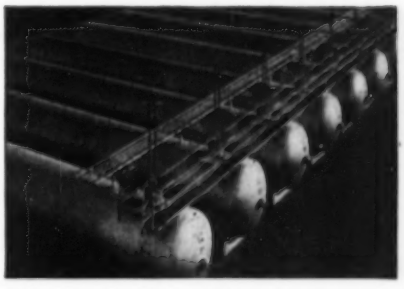

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Then clip and mail the coupon for a factual booklet, "Protecting Underground Pipe from Corrosion with NO-OX-ID and NO-OX-IDized Wrappers." Or, better still, call in your Dearborn Pipeline Engineer and talk it over.

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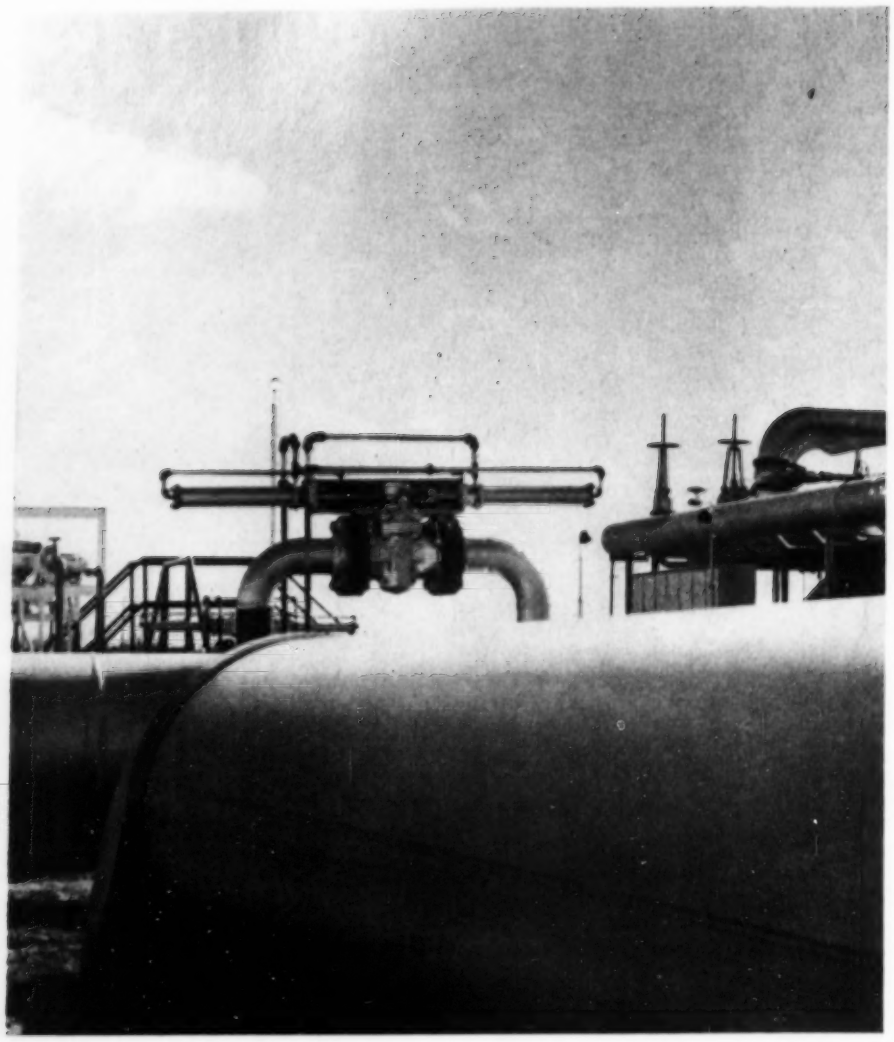
City.....*Zone*.....*State*.....

point *plus* the additional 100-ft altitude of the plane at time of reading. The profile that will be developed from this method of cross calibration is known as the "theoretical profile" and is, in fact, a true portrayal of the ground beneath. In the final plotting of the path, this theoretical profile is eventually lowered, raised or tilted so that the terminal end points of the graph fall into agreement with the actual site elevations that have been previously established by ground survey methods.

Most aerial survey measurement runs are made at altitudes approximately the proposed beam path. This is done for two reasons. First, by actually flying the path to be traversed by the signal we can best evaluate the propagation problems that may develop. Secondly, at low altitudes the radar "splash" pattern is smaller and therefore integrates less of the terrain below in one reading.

At these altitudes it is obviously impossible for the pilot to use normal navigational methods, for in rough terrain his horizon is only seconds away. To counteract this inability of the flight crew to fly by normal visual methods, a system of "target over" identification is used.

Prior to the low level measurement run, the plane is flown over the path several times on reconnaissance runs. Landmarks beneath are noted in terms of seconds out from target zero (starting point). By retracing the path several times sufficient check points are normally developed to provide at least one in sight at all periods of the low level passes. These landmarks or check points are carefully plotted on the flight map and are later used in adjusting the indicated plane speed with the readings. On low level runs the co-pilot observer continually calls out the next target while the pilot records the counter reading over each check point. This inter-plane conversation is recorded on tape and when played back against the movie film, the actual position of the plane and the grouping of the readings can be accurately determined. Over areas where there are no landmarks the plane is equipped to drop identifying markers along the path which will later serve as check points. Such a system of navigation or piloting assumes an accurate tracing of the flight



AUTOMATIC BLOWDOWN SYSTEM FOR COMPRESSOR STATION OPERATED BY LEDEEN VALVE ACTUATORS

LEDEEN TIME DELAY VALVE

When lightning strikes or power fails, this new valve keeps station on line. If power is not restored within adjustable time delay limit set by the valve (2 seconds to 2 minutes), station is blown down and lines vented. Write for data on this compressor station watchdog.

New AGA Code Revision Specifies Emergency Shutdown Facilities...

"Each transmission compressor station shall be provided with an emergency shutdown system by means of which all gas compressing equipment, all gas fires, and all electrical facilities in the vicinity of gas headers and in the compressor building can be shut down and the gas can be blocked out of the station and the station gas piping blown down." (per Paragraph 843.431, Emergency Shutdown Facilities, Revision of Section 8 of ASA B31.1).

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TRADE DARLING MARK McEvoy

New self-sealing two-way conduit valve for pipeline service automatically injects sealant by means of existing line pressure

Here's a new type of conduit gate valve, available in 8-inch and larger sizes, that gives positive downstream closure without dependence on metal-to-metal contact. Each time the valve closes, the required amount of sealant is applied automatically.

How it works

Employing the time-tested McEvoy principle, two cylinders, filled with special sealant, are located within the valve. Both are operated by line pressure. Depending on the direction of flow, line pressure actuates one or the other of these cylinders to force sealant into a channel in the downstream face of the seat. Since these cylinders hold enough sealant for 50 or more closures, the valves need only periodic servicing for recharging with sealant.

Write for details

Ask for bulletin #5402 which contains complete information on the design and operation of this valve.

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Radar Profiling... Complete aerial photographic equipment is carried in flight for substantiation

line and permits the all-important retracing of the path for corroboration of the profile.

The survey plane is basically a standard commercial type ship "beefed up" for the extra-hazardous flying it must perform. The crew is equipped with crash helmets, safety belts, shoulder straps, survival kits and life preservers against the ever-present possibility of an engine failure and subsequent "wheels up ditching." Wing tip tanks have recently been installed to increase the effective flying range as well as to remove the gasoline hazard from the working cockpit. Full flight instrumentation as well as complete radio equipment permits operations in all but zero flying conditions.

Complete aerial photographic equipment is carried in flight, ranging from standard aerial cameras to Polaroid 3-D color, and motion pictures; this equipment's use is usually limited to photographic substantiation and not as a method for measurement. For that reason the cost of operation of the photo equipment is but a small fraction of a photogrammetry installation both in air and on ground. With this choice of coverage, it is possible to bring back a complete photographic as well as topographic description of the path.

At the completion of the day's work, all film, both aerial and motion picture, is developed and scanned in order to assure that the data collected are both complete and usable before moving the plane on to the next base.

If the data are in order, the motion picture films are then read and transcribed on profile charts, each reading being plotted in the horizontal position along the flight line that was reported from the in-flight tape. Low level runs are made over each path from each direction to provide the all-important cross check on the validity of the profile. For interpretation purposes, these two separate curves are plotted in different colors as they may or may not immediately coincide, depending on the changes in area pressure that occurred during the interval between making the dual runs. If the two curves do not overlay each other they must be completely similar in structure even though vertically displaced to be acceptable.

The resultant profile, comprising the highest readings at each point during these two successive runs, is then adjusted on the curvature so that the terminals of the curve coincide with the site altitudes developed by the ground survey crew from USGS bench marks.

From this finalized graph, which accurately portrays the terrain profile between the two selected sites, the clearance between the line of site between assumed tower tops and the ground is established. From such data, coupled with an evaluation of the atmospheric considerations along the route, the design engineer can then lay out the details of his system.

Obviously, there are many many details of aerial surveying that cannot be detailed in this article without undue wordage. The technique has been proved accurate, fast and economical in many field applications and has been the basis of developing design criteria for a large portion of the modern microwave systems. ■

Griffis—B&M

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Constructing 92 miles 22-inch line
for Pacific Northwest Pipeline Corp.
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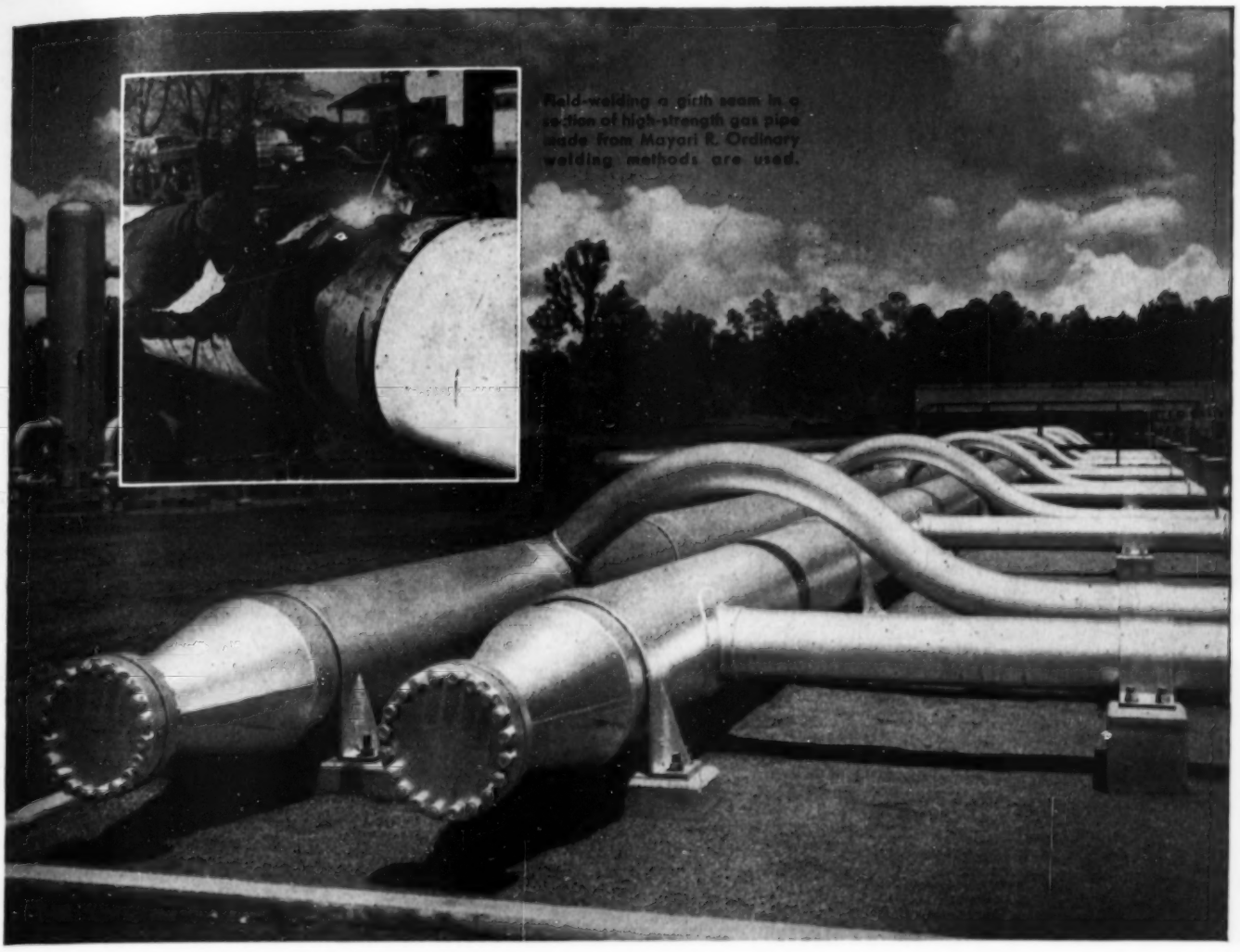

The 30-inch pipe, header tees and swages shown above were all fabricated from Mayari R, Bethlehem's high-strength, low-alloy steel.

This high-strength pipe is easy to weld

Pipe made from Mayari R—Bethlehem's high-strength, low-alloy steel—has welding properties equal or superior to those of other pipe having the same load-carrying capacity. Simply follow your usual field-welding practices, using ordinary mild-steel rods. The weld metal will pick up enough alloy content to match the Mayari R's high mechanical properties. Under normal conditions, there's no need to preheat unless the pipe walls exceed ¾ in.

Resists Fatigue—Mayari R steel combines high-strength with extreme ductility. Its physical properties include a yield point of 50,000 psi min; ultimate tensile strength of 70,000 psi min; and an unusually high endurance limit of 60 to 70 pct of the tensile strength. As a result, pipe fabricated from Mayari R has the ductility, resistance to fatigue and the impact qualities needed to handle vibration and other severe stresses encountered at compressor stations.

Savings of Materials and Money—Due to its superior mechanical properties, high-strength gas pipe made from Mayari R may be used in lighter wall thicknesses than ordinary carbon-steel pipe.

Ask the nearest Bethlehem sales office for complete information about Bethlehem Oil and Gas Pipe, whether made of high-strength Mayari R, or ordinary carbon steel meeting ASTM A134 and API 5LX42.

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Inadequate means of corrosion identification revealed by survey

The relative importance of underground corrosion causes was revealed by 28 companies in a survey conducted by the AGA corrosion committee and reported on by Frank E. Kulman, Consolidated Edison Co. of New York, at the distribution conference held in Cincinnati in April.

WHILE all companies report corrosion by soil, the means of identifying corrosive soil are regarded as adequate by only 10 companies. The most common methods for identifying corrosive soil are measurement of soil resistivity, observation of wetness or dampness, measurement of soil pH, and presence of dense soil. However, none of these methods gives a quantitative measure of the oxygen content or aeration of the soil.

It is significant that 19 companies report that at least 60% of their corrosion leaks are caused by corrosive soil. Yet the means of identifying corrosive soils are not adequate. The conclusion is inescapable that better test methods should be developed for measuring corrosiveness of soils.

Corrosion and pitting of buried structures have been identified with poorly aerated soils in which anaerobic bacteria flourish. For the purpose of this study, bacterial corrosion is considered as a special type of soil corrosion. The conditions that favor bacterial corrosion are absence of oxygen in the soil and the presence of moisture, sulfates and organic matter. Sulfate-reducing bacteria thriving in such soils reduce sulfates and sulfides. The corrosion products on steel pipe include a white pasty substance (ferrous hydroxide) next to the pipe, surrounded by a black layer of ferrous sulfide. The white hydroxide and ferrous carbonate, if present, turn brown when exposed to air. Tests for sulfide can be made by placing the corrosion product in dilute hydrochloric acid. The presence of hydrogen sulfide gas is an indication that bacterial corrosion has occurred.

Several different explanations of the manner in which bacteria affect the electro-chemical process of corrosion have been proposed. These include the bacterial removal of polarizing hydrogen at cathode surfaces, and the creation of anodic areas on the pipe at points where the soil oxygen is removed by bacteria and fungi in decomposing organic matter. Bacterial corrosion has been reported to be seasonal, being most intense in the late spring.

Of the 20 companies that have made tests for bacterial corrosion, nine reported the presence of sulfide in less than 20% of the tests. Eleven companies reported the presence of sulfide in at least 40% of the tests, including two companies that found sulfide in at least 80% of their tests.

It should be remembered that the test for ferrous sulfide can be made only after the corrosion has occurred and this test cannot be made to predict the corrosiveness of soils before laying pipe.

Only two companies regard the means for identifying bacterial corrosion as adequate. Twenty-two find the present methods inadequate. Again the conclusion is evident that methods should be developed for determining in advance of pipe laying whether bacterial corrosion will occur.

Most of the replies urged the devel-

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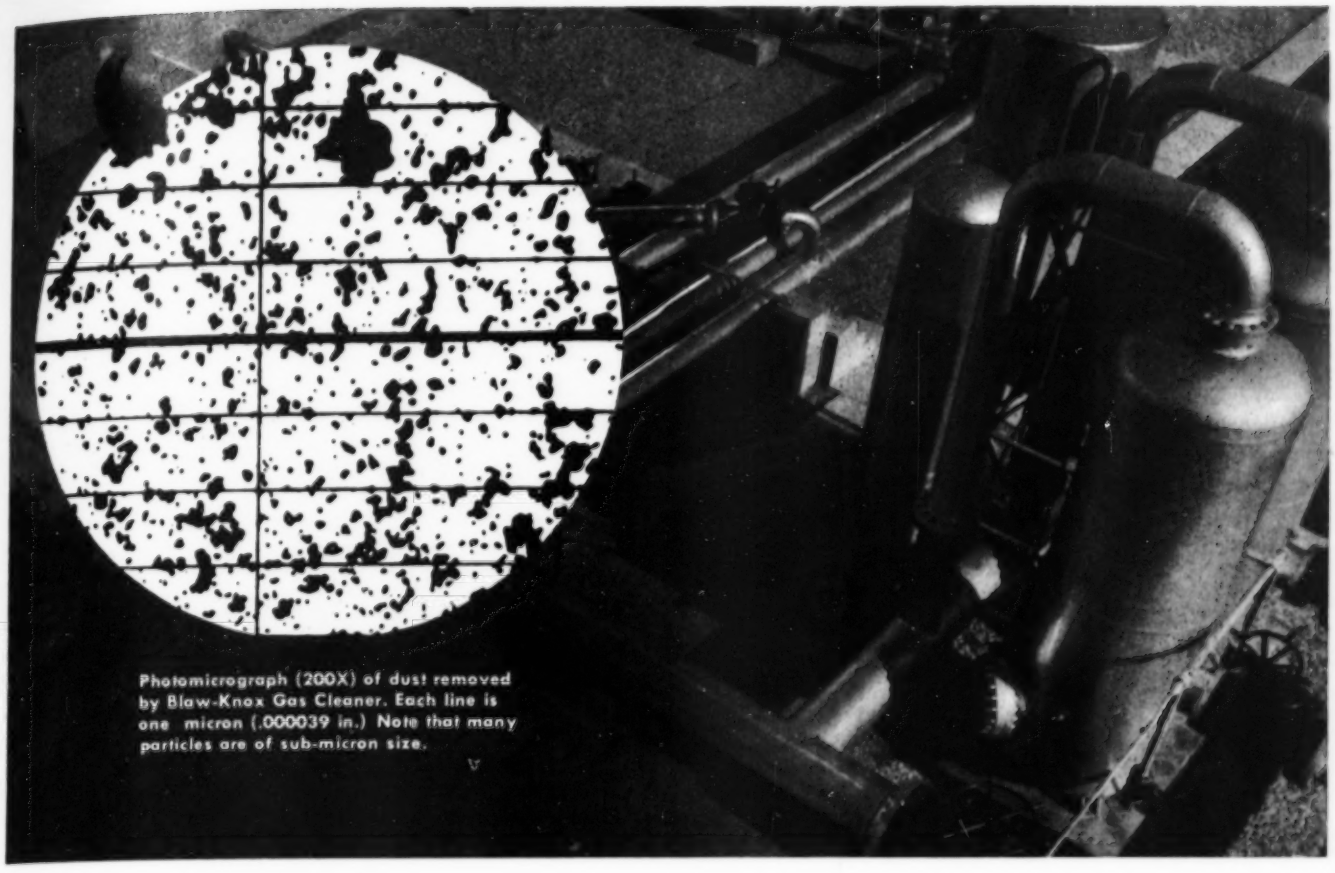

Photomicrograph (200X) of dust removed by Blaw-Knox Gas Cleaner. Each line is one micron (.000039 in.) Note that many particles are of sub-micron size.

dust particles 20 microns and below travel easiest, farthest — do the most damage

Field tests prove Blaw-Knox Gas Cleaners remove even the smallest dust particles

The test of any gas cleaner's efficiency should be measured *not* in terms of the amount of dust collected, but in terms of the quantities entrained in the "clean" gas. The removal of a high percentage of large dust particles is a relatively easy task. However, it is the particle sizes of 20 microns and below that travel easiest, farthest and cause the most damage. Blaw-Knox Gas Cleaners remove even the smallest particles of these dusts.

A large number of field performance tests have been run to determine the dust removal capacity of Blaw-Knox Gas Cleaners. Inlet dust loadings ranged up to 547 pounds per million cubic feet of gas. Tests on the cleaner outlet showed absolutely no dust getting past.

The ability of Blaw-Knox Gas Cleaners to maintain such performance is due to an exclusive operating principle through which each tiny particle of dust is placed immediately in violent, intimate contact with oil. In the expansion separation stages, a major portion of dust-laden oil drops out of the gas stream. An oil-wet, multiple baffle, primary separator catches and agglomerates the remaining tiny wet particles. Finally the gas is scrubbed by an efficient, multiple vane mist extractor.

When you buy, be sure to specify Blaw-Knox, for when you place a Blaw-Knox Gas Cleaner on stream, you're sure to remove even the smallest particles of dust.

Blaw-Knox Electroil and Portable Hot Oil Foggers provide a safe, compact, efficient means of producing a stable oil fog in your gas streams.

A STABLE OIL FOG IN YOUR GAS MAINS:

Will wet down existing dust deposits.

Will prevent drying out and eventual dislodging of existing wet deposits.

Will moisten leather diaphragms.

Will curb internal corrosion of steel mains.

Will prevent loss of odorant by reaction with pipe scale.

Will help to prevent drying out of jute-joint packing.

BLAW-KNOX

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Buflovak Equipment Division
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opment of methods for detecting corrosive soil. Previous research by Starkey and Wight sponsored by the AGA, resulted in the preliminary design of the soil redox probe for this purpose. The recommendation of the corrosion committee that the Starkey and Wight redox probe be ruggedized into a practical field tool for use of the corrosion engineer has been approved and development work on the redox probe is now under way.

Redox is an abbreviated form of oxidation-reduction. Oxidation-reduction, or redox, is a measure of the tendency for a substance to give up or take up electrons. That is, it is a quantitative measure of the free energy of the chemical reaction which is involved in the electron transfer. Oxidation involves the loss of electron and reduction the gain of the electrons. Oxidation takes place only when there is a corresponding reduction at another point in the electro-chemical process.

Redox potential of an electrolyte is the potential difference between an inert metal electrode (such as platinum) and a reference electrode (such as a calomel or hydrogen electrode). The potential difference measured depends only on the nature of the substance in the electrolyte and their concentrations.

In a simple electrolyte containing ferrous and ferric salts such as $Fe\,SO_4$ and $Fe_2\,(SO_4)_3$, the opposing tendencies are those of ferric ions (Fe^{+++}) to give up positive charges to the platinum electrode and of ferrous ions (Fe^{++}) to take up charges from the electrode. If the driving force of the reaction

$$Fe^{+++} \rightarrow Fe^{++} + (+)$$

exceeds that of

$$Fe^{++} + (+) \rightarrow Fe^{+++}$$

the electrode will become positively charged.

The variation of potential of the electrode with ionic concentrations may be calculated from the formula

$$E = Eo + 0.058 \log \frac{C}{C'}$$

where C is the concentration of ferric, and C′ the concentration of ferrous ions. The potential Eo is the single electrode potential when $C = C'$, that is when the electrolyte contains equal numbers of ferric and ferrous ions.

Soils are complex systems in which metals other than iron are present, together with ions such as chloride, sulfate, carbonate, hydroxide, nitrate and others. The redox potential of soil thus is dependent on the concentrations of the various metallic ions in the higher and lower states of oxidation.

The redox potential, dependent on the ionic concentrations, expresses only the intensity of the reduction or oxidation and gives no evidence of the amounts of oxidized and reduced ions in the electrolyte.

Low redox potential indicates an anaerobic, reducing environment, favorable for corrosion and pitting of buried metals. In an anaerobic soil, the ferrous ions from a corroding structure may migrate a relatively long distance before they are precipitated. Thus, protective corrosion products are not formed close to the anodic areas on the pipe, tubercles do not form, and the corrosion process continues unabated. In an aerated soil, however, the redox potential would tend to be high and the ferrous ions would be oxidized and precipitated in close proximity to the anodes. Tubercles formed under these conditions at the anodic areas prevent the further migration of ferrous ions and thereby stifle the corrosion process. The net result is that corrosion is more severe in the poorly aerated soil.

An anaerobic environment is also favorable to the growth of sulfate-reducing bacteria. These bacteria reduce soil sulfates to sulfides and the association of these bacteria with the corrosion

"You can bet your boots coal tar is better'n asphalt for pipe!"

"Son, ever notice how things do better in surroundings they're used to? You and me in pipelining find it true there, too. Take coal tar pitch, for instance, use it as an enamel on pipe and wrap the pipe with asbestos saturated with coal tar and you've got a line that lasts for years and years. But I've seen lines laid where asphalt was used—never stayed down long, either. Too porous and usually has a little salt in it. First thing you know your coating and wrappings fighting again' you instead of with you.

"I've seen coal tar pitch that'd been underground 75 years and still in good shape—was on the foundation of the old Grand Central Station in New York. Yessir, asphalt makes good roads and things where the sun gets to it—but underground it's best to use coal tar, otherwise you're trying to work against nature. You can bet your boots coal tar pitch is better'n asphalt to go on pipe.

"Ran across an S. D. Day man the other day out on a line being laid and he really knows about coal tar and other things made from it. It's used in a couple of products they handle—PITT-CHEM enamels and RUBEROID asbestos felt.

"From all I ever hear they've got the best products and service I know of. Give them a call soon, son."

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CALOR has the experts! Calor's industrial department puts trained specialists at your service to help in planning your LP-Gas requirements. For a more complete service all ways...always call CALOR...the West's Leading Independent Marketer of LP-Gas.

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process is indicated by the frequent presence of ferrous sulfide in the corrosion products in poorly aerated soil.

Looking to the future and anticipating the successful outcome of the development and calibration of the ruggedized redox probe, it is possible that redox potential surveys will be made in connection with new construction and also maintenance of existing piping systems. A few of the applications envisioned for the redox probe are as follows:

The probe could be used for locating corrosive soils before laying pipe and thus provide information and data on which engineering decisions can be made as to where insulating joints should be installed, where the steel or cast iron pipe sections should be coated, and where cathodic protection should be applied.

The probe could be used to advantage on existing bare piping systems, particularly in city streets, to determine the extent of corrosive soil under the pavement, and thus assist the engineer in decisions as to how much pipe should be replaced or reconditioned when leaks start occurring.

There is a Plico *Engineered* Pipe Enamel for every pipeline application

Plico Pipe Enamels, compounded by coating engineers experienced in solving underground corrosion problems, are *engineered* for specific conditions.

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GAS pipeline news

Nearly 1.75 billion cu ft additions authorized by FPC

During the 12-month period ended June 30, 1955, the FPC authorized construction of more than 4900 miles of natural gas pipeline as part of new facilities designed to add nearly 1¾ billion cu ft of daily delivery capacity to the nation's individual transmission systems, FPC Chairman Jerome K. Kuykendall reports.

The new facilities, which include nearly 260,000 hp in compressor units, have an estimated total construction cost of approximately $465,300,000. These statistics do not cover authorizations issued to independent producers who first began filing applications with the FPC in August of 1954.

On the following pages (241 and 242) is the table of construction jobs authorized by the commission from January to June 1955.

Major projects—those having an estimated cost of $700,000 or more each—accounted for about $456,969,000 of the total construction cost. The larger projects, which will increase the daily delivery capacity of the individual transmission systems involved by more than 1,614,000,000 cu ft of natural gas per day, are expected to benefit 113 cities of 50,000 population or over in 22 states and the District of Columbia as well as numerout smaller communities. These projects involve construction of approximately 4600 miles of new pipeline and installation of compressor facilities totaling nearly 255,000 hp.

The largest single authorization was issued to American Louisiana Pipe Line Co. for its proposed $123 million Louisiana-to-Michigan system. This project consists of 1004 miles of 30-in. main line, with 82 miles of 24-in. supply laterals, 86 miles of miscellaneous 6-in. to 12-in. supply feeder pipelines in Louisiana, and 30,000 hp in three main-line compressor stations.

During the preceding 12-month period, ended June 30, 1954, FPC author-

(Continued on page 244)

CONSTRUCTION JOBS APPROVED BY FPC — JANUARY-JUNE 1955

Applicant and Docket No.	Description and Purpose	Estimated Cost	Communities Benefited (50,000 or more population)
Cities Service Gas Co. G-2383 July 8, 1954	24 miles of 26-in. and 9 miles of 20-in. in Johnson county, Kan. and Jasper county, Mo.; to increase pressures in Ottawa, Kan. station to increase deliveries by 46 MMcf for existing customers in Kansas City and Springfield, Mo.	$ 1,860,500	Kansas—Kansas City, Topeka and Wichita. Missouri—Kansas City.
Arkansas Louisiana Gas Co. G-2307 July 16, 1954	136 miles of 6- to 24-in. loops and laterals, a 10,500-hp station in Arkansas. To increase capacity by 146 MMcf.	10,072,305	Arkansas—Little Rock.
Hope Natural Gas Co. G-2412 July 22, 1954	20 miles of 6- to 16-in. lines in Kennedy storage area in West Virginia. To increase ultimate capacity.	742,396	None.
Hope Natural Gas Co. G-2413 July 22, 1954	23 miles of 12 in. laterals from Logan, W. Va. to Boone county, W. Va. To receive and transport 27 MMcf a day for Carnegie Natural Gas Co.	928,200	None.
Kansas-Nebraska Natural Gas Co. Inc. G-2392 July 23, 1954	221 miles of 6- to 12-in. lines and laterals, and additions of 2700 hp in Big Springs and North Platte, Neb., stations. To rearrange system to increase capacity by 6 MMcf.	4,096,890	Nebraska—Lincoln.
Lone Star Gas Co. G-2005 Aug. 16, 1954	5 miles of 12-in. connecting a new 2640-hp storage compressor station in Clay county, Texas.	762,687	Texas—Dallas, Fort Worth, Waco, Wichita Falls and San Angelo.
Montana-Dakota Utilities Co. G-2414 Aug. 16, 1954	49 miles of 12-in. lines in South Dakota, Wyoming and Montana, and 440-hp additional compressor units in Little Beaver station in Montana. For service to existing customers in the Billings, Mont. and Rapid City, S. D. area.	1,366,944	None.
Manufacturers Light & Heat Co. G-2479 Aug. 16, 1954	61 miles of 4- to 16-in. transmission and lateral replacements in Ohio, Pennsylvania, and West Virginia and 1760 hp units in Brinker storage pool, Ohio station. To rearrange system for increased deliveries from Brinker and Heard storage fields for existing customers in Pennsylvania and West Virginia.	4,099,250	Pennsylvania — Allentown, Bethlehem, Erie, Harrisburg, Reading and York. West Virginia—Charleston, Huntington and Wheeling.
South Georgia Natural Gas Co. G-1915 Sept. 2, 1954	368 miles of 2- to 12-in. transmission and lateral lines from a connection with Southern Natural in Lee county, Ala., extending to Albany, Ga. and Tallahassee, Fla., to receive an initial supply of 21 MMcf from Southern Natural for service in 11 Georgia and three Florida towns.	8,969,429	None.
Texas Eastern Transmission Corp. G-2472 Sept. 20, 1954	58 miles of 16- and 20-in. lines from Carthage field to facilities at Joaquin and Longview, Texas. To regulate and transfer gas between two main lines and to save the transportation charges now being paid.	3,269,000	None.
Trunkline Gas Co. G-2509 Sept. 20, 1954	A 6350-hp station on a supply line at Edna, Texas. To eliminate bottle neck on a supply lateral.	1,563,800	None.
American Louisiana Pipe Line Co. G-2306 Oct. 1, 1954	1004-mile, 30-in. line from North Tepitate, La. to Detroit; 82-mile, 24-in. laterals in Louisiana; 86 miles of miscellaneous 6- to 12-in. feeders in Louisiana, and 30,000 hp in three mainline stations. To have an initial capacity of 300 MMcf for its affiliates: Michigan Consolidated Gas Co., Milwaukee Gas Light Co., and Michigan-Wisconsin Pipe Line Co. (Note: Other facilities including 117 miles of 22-in. pipeline involving nearly $8 million are pending further order of commission.)	122,917,000	Michigan — Dearborn, Detroit and Grand Rapids. Wisconsin—Milwaukee, Green Bay, Kenosha, Madison and Racine.
Texas Gas Transmission Corp. G-2311 Oct. 1, 1954	48-mile, 26-in. main line loops and 1500-hp addition in Covington, Ky. station. To deliver 51 MMcf a day to American Louisiana Pipe Line Co. in Kentucky.	4,281,135	Same as No. No. G-2306
Ohio Fuel Gas Co. G-2464 Oct. 7, 1954	46 miles of 20- and 24-in. partial loops between Jackson, Ohio and Crawford station and 3000 hp addition in Crawford. To receive an additional 48 MMcf from United Fuel Gas Co. for storage.	3,832,700	Ohio—Cincinnati, Columbus, Dayton, Hamilton, Springfield and Toledo.
Montana-Dakota Utilities Co. G-2382 Oct. 19, 1954	4-mile, 10-in. lateral to Big Horn gasoline plant and 2640-hp compressor station in Big Horn county, Wyo. To increase system capacity by 10 MMcf for existing customers.	789,676 (Including Compressor Station)	None.
Cities Service Gas Co. G-2542 Oct. 19, 1954	6 miles of 4- to 16-in. storage field lines and 4050 hp addition in Welda station, Kansas. To increase deliverability from storage.	1,426,690	Kansas—Kansas City, Topeka and Wichita. Missouri—Kansas City.
Ohio Fuel Gas Co. G-2495 Nov. 1, 1954	28 miles of 5- to 16-in. loops and replacements and an addition of 140 hp in Urbana, Ohio, station.	832,700	None.
Ohio Fuel Gas Co. G-2522 Nov. 1, 1954	11-mile, 20-in. line from Benton storage area to Crawford compressor station and 880 hp in Guernsey county, Ohio. To increase service from storage areas to meet increased demands of existing customers.	942,900	Ohio—Cincinnati, Columbus, Dayton, Hamilton, Springfield and Toledo.
Tennessee Gas Transmission Co. and Iroquois Gas Corp. G-2310 Dec. 28, 1954	4000 additional hp in Tennessee's station 229, metering and regulating facilities and miscellaneous storage facilities in New York. To jointly develop and utilize additional storage for existing customers in New York and New England areas. (Tennessee also requests authorization to acquire one-half interest in the storage area from Iroquois.)	7,754,653	Connecticut — Bridgeport, New Britain and Stamford. Massachusetts — Holyoke, Lawrence, Lowell, Lynn, Malden, Medford, Springfield and Worcester. New Hampshire—Manchester. New York — Albany, Binghamton, Buffalo, Rochester, Syracuse, Troy and Utica.
Tennessee Gas Transmission Co. and New York State Natural Gas Corp. G-2330 Dec. 28, 1954	New storage in Pennsylvania and New York consisting of 23 miles of 6- to 12-in. field lines and 11,000-hp compressor station. To jointly develop and utilize new storage for existing customers in New York, Pennsylvania, and New England areas. (Tennessee also requests authorization to acquire one-half interest in this storage area from New York State Natural.)	11,888,673	Connecticut — Bridgeport, New Britain and Stamford. Massachusetts — Holyoke, Lawrence, Lowell, Lynn, Malden, Medford, Springfield and Worcester. New Hampshire—Manchester. New York — Albany, Binghamton, Buffalo, Rochester, Syracuse, Troy and Utica. Pennsylvania—Altoona, Johnstown and Pittsburgh.

Continued on page 242

Continued from page 241

Applicant and Docket No.	Description and Purpose	Estimated Cost	Communities Benefited (50,000 or more population)
Tennessee Gas Transmission Co. G-2331 Dec. 28, 1954	243-mile, 24-in. line from Hebron, Pa., through New Jersey and New York to a point near Greenwich, Conn., and 18-mile, 24-in. connecting line to Harrison storage field in Pennsylvania. To rearrange system to deliver gas from new sources and from storage to new and existing customers in the New York Metropolitan and New England areas.	28,700,000	Connecticut — Bridgeport, New Britain and Stamford. Massachusetts — Holyoke, Lawrence, Lowell, Lynn, Malden, Medford, Springfield and Worcester. New Hampshire—Manchester. New York — Albany, Binghamton, Buffalo, Rochester, Syracuse, Troy and Utica.
Transcontinental Gas Pipe Line Corp. G-2367 Dec. 28, 1954	173 miles of 30- and 36-in. mainline loops and 58 miles of 12- to 24-in. laterals in New Jersey. To increase system capacity by 37 MMcf for existing customers in New York City and Newark, N. J. areas.	29,700,000	New Jersey—Atlantic City, Bayonne, Camden, Clifton, East Orange, Elizabeth, Hoboken, Irvington, Jersey City, Newark, Passaic, Paterson, Trenton and Union City. New York—New York City (All Boroughs).
New York State Natural Gas Corp. and Texas Eastern Transmission Corp. G-2784 Dec. 28, 1954	8 miles of 6- to 20-in. storage lines in Murrysville pool, Pa., and 1980 hp addition in Oakford storage station (Oakford to be acquired from Peoples Natural Gas Co.). To jointly expand the operations of the storage areas.	726,300	New York — Albany, Binghamton, Buffalo, Rochester, Syracuse, Troy and Utica. Pennsylvania—Altoona, Johnstown and Pittsburgh.
Transcontinental Gas Pipe Line Corp. G-2406 Dec. 29, 1954	25-mile, 12-in. feeders from connection with Texas Gas Pipe Line Co. to applicant's main line in Louisiana. To take additional supply of 100 MMcf a day from Texas fields.	1,076,000	None.
Alabama Tennessee Natural Gas Co. G-2534 Jan. 4, 1955	25-mile, 8- and 12-in. lines and 350-hpstation in Alabama.	808,150	None.
El Paso Natural Gas Co. G-2462 Feb. 3, 1955	74 miles of 6- to 14-in. miscellaneous lines in Texas, New Mexico and Arizona, and 6925 hp addition in stations in Texas and New Mexico. To receive an additional supply of 52 MMcf a day.	13,869,017	Arizona—Phoenix. California — Alameda, Alhambra, Berkeley, Burbank, Fresno, Glendale, Long Beach, Los Angeles, Oakland, Pasadena, Richmond, Sacramento, San Bernardino, San Diego, San Francisco, San Jose, Santa Monica, South Gate and Stockton.
United Gas Pipe Line Co. G-2818 Feb. 25, 1955	29 miles of 2- to 12-in. supply laterals and miscellaneous facilities in Louisiana, Texas and Mississippi.	1,510,515	None.
Transcontinental Gas Pipe Line Corp. G-4185 March 7, 1955	362-mile, 30- and 36-in. loop on system between Texas and New York, 2 miles of field laterals and 9600 hp in two new stations. To increase system capacity 83 MMcf.	48,205,000	New Jersey—Atlantic City, Bayonne, Camden, Clifton, East Orange, Elizabeth, Hoboken, Irvington, Jersey City, Newark, Passaic, Paterson, Trenton and Union City. New York—New York City (All Boroughs).
Texas Gas Transmission Corp. G-6854 March 31, 1955	207 miles of 8- to 26-in. loop in Louisiana, Indiana, Tennessee and Kentucky and 22,600 hp in new and existing stations on mainline between Texas and Ohio. To increase system capacity by 92 MMcf a day to meet increased demands of existing customers, particularly in Indiana and eastward.	17,498,519	Indiana—Terre Haute and Evansville. Kentucky—Louisville. Ohio—Cincinnati, Columbus, Dayton, Hamilton, Springfield and Toledo.
Tennessee Gas Transmission Co. G-8215 April 7, 1955	370-mile, 30-in. line from Nueces county, Texas, to near Kinder, La. To transport 270 MMcf a day from Texas to Louisiana. (Note: Proposed in lieu of facilities previously authorized but not yet constructed having a capacity of 220 MMcf a day.) Pennsylvania — Altoona, Johnstown, Pittsburgh, Allentown, Bethlehem, Erie, Harrisburg, Reading and York. Tennessee—Nashville. Virginia—Arlington, Norfolk, Portsmouth and Richmond. West Virginia—Charleston, Huntington and Wheeling.	35,400,000 ←	Connecticut—Bridgeport, New Britain and Stamford. District of Columbia—Washington. Indiana—Evansville. Kentucky—Lexington and Covington. Maryland—Baltimore and Silver Spring. Massachusetts — Holyoke, Lawrence, Lowell, Lynn, Malden, Medford, Springfield and Worcester. New Hampshire—Manchester. New York — Albany, Binghamton, Buffalo, Rochester, Syracuse, Troy and Utica. Ohio—Cincinnati, Columbus, Dayton, Hamilton, Springfield, Toledo, Akron, Canton, Cleveland, Cleveland Heights, Lakewood and Youngstown.
Atlantic Seaboard Co. G-6500 April 29, 1955	84 miles of 26-in. loops on mainline in West Virginia, Virginia and Maryland and a 2000 hp addition in Cleveland station, West Virginia. To receive an additional supply of 71 MMcf a day.	9,281,500	District of Columbia—Washington. Maryland—Baltimore and Silver Spring. Virginia—Arlington, Norfolk, Portsmouth and Richmond.
Gulf Interstate Gas Co. G-6863 April 29, 1955	3500-hp station on mainline near Stanton, Ky. To test on a standby basis a new type of compressor station for efficiency, fuel use and cost of operations.	730,000	None.
Michigan Gas Storage Co. G-6501 May 6, 1955	36 miles of 16-in. line between Mt. Pleasant and Zilwaukee junctions and an addition of 3300 hp in Freedom station, Michigan. To receive increased supplies from Panhandle Eastern to be delivered to storage.	2,572,000	Michigan — Dearborn, Detroit and Grand Rapids.
New York State Natural Gas Corp. G-8568 June 10, 1955	21 miles of 20-in. loop in Livingston and Wyoming counties, N. Y. To increase system capacity by 4 MMcf a day.	1,225,000	New York — Albany, Binghamton, Buffalo, Rochester, Syracuse, Troy and Utica.
Kentucky-West Virginia Gas Co. G-8433 June 17, 1955	32 miles of 12-in. line from connection with Clinchfield Coal Corp. at Kentucky-West Virginia stateline to own facilities at Maytown, Ky., and 4 miles of 12-in. field supply lateral in Kentucky. To replace shrinkage of about 13 MMcf a day in the volume of gas which is to be delivered to a subsidiary for extraction of chemicals.	1,455,000	None.
Texas Eastern Transmission Corp. G-2503 June 24, 1955	382 miles of 24-in. supply line from Beaumont, Texas to Kosciusko, Miss., 29 miles of 20-in. line from Baytown to Hankamer, Texas, 71 miles of 3- to 10-in. supply and sales laterals, and 122,920 hp in new and existing mainline compressor stations. To replace the loss in system capacity caused by abandonment of the Little Inch pipeline and construct facilities on another portion of system to transport and deliver 200 MMcf.	71,814,000	None.

Story continued on page 244

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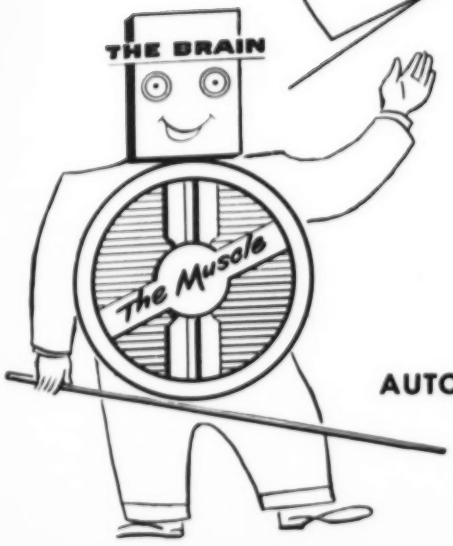

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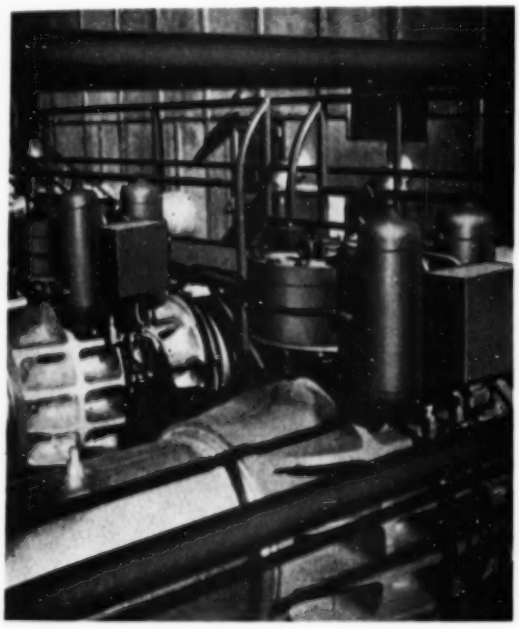

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ized a total of more than 6400 miles of pipeline and installation of approximately 252,000 hp at a total estimated cost of $500,881,000. Compared with the year ended June 30, 1955, these totals are higher for mileage and cost, but lower for compressor station horsepower. Facilities authorized for each of the two 12-month periods are designed to add approximately the same total amount of daily delivery capacity to the individual pipeline systems—about 1¾ billion cu ft.

SUMMARY OF NATURAL GAS CERTIFICATES ISSUED BY THE FEDERAL POWER COMMISSION BETWEEN FEB. 7, 1942 AND JUNE 30, 1955 (RIGHT)

Since Feb. 7, 1932 (the date the certificate provisions of the Natural Gas Act became effective), the FPC has authorized a total of more than 64,000 miles of pipeline and nearly 4.4 million hp in compressor units at a total estimated cost of more than $4,852,000,000. Major projects authorized during this 13½ year period are designed to add more than 23½ billion cu ft of daily delivery capacity to the individual pipeline systems in the United States.

Certificates	Total Miles of Lines	Total Additional Compressor Horsepower	Estimated Cost
Feb. 7 - June 30, 1942 1	20	—	$ 86,800
July 1, 1942 - June 30, 1943 4	51	3,560	1,642,509
July 1, 1943 - June 30, 1944 25	2,373	108,490	106,082,485
July 1, 1944 - June 30, 1945 43	1,181	66,610	34,170,760
July 1, 1945 - June 30, 1946 52	2,994	184,275	127,189,731
July 1, 1946 - June 30, 1947 132	5,369	360,349	273,190,302
July 1, 1947 - June 30, 1948 98	8,468	371,310	519,945,633
July 1, 1948 - June 30, 1949 91	7,045	436,274	566,203,116
July 1, 1949 - June 30, 1950 108	6,188	493,340	487,240,014
July 1, 1950 - June 30, 1951 173	8,695	736,135	725,432,984
July 1, 1951 - June 30, 1952 136	3,378	539,510	321,919,895
July 1, 1952 - June 30, 1953 133	7,123	582,715	723,037,744
July 1, 1953 - June 30, 1954 165	6,405	251,540	500,881,248
July 1, 1954 - June 30, 1955 140	4,927	259,039	465,324,175*

*During this 12-month period projects costing $700,000 or more each accounted for the following: Certificates, 36; miles, 4565; additional compressor horsepower, 254,775; estimated cost, $456,968,529.

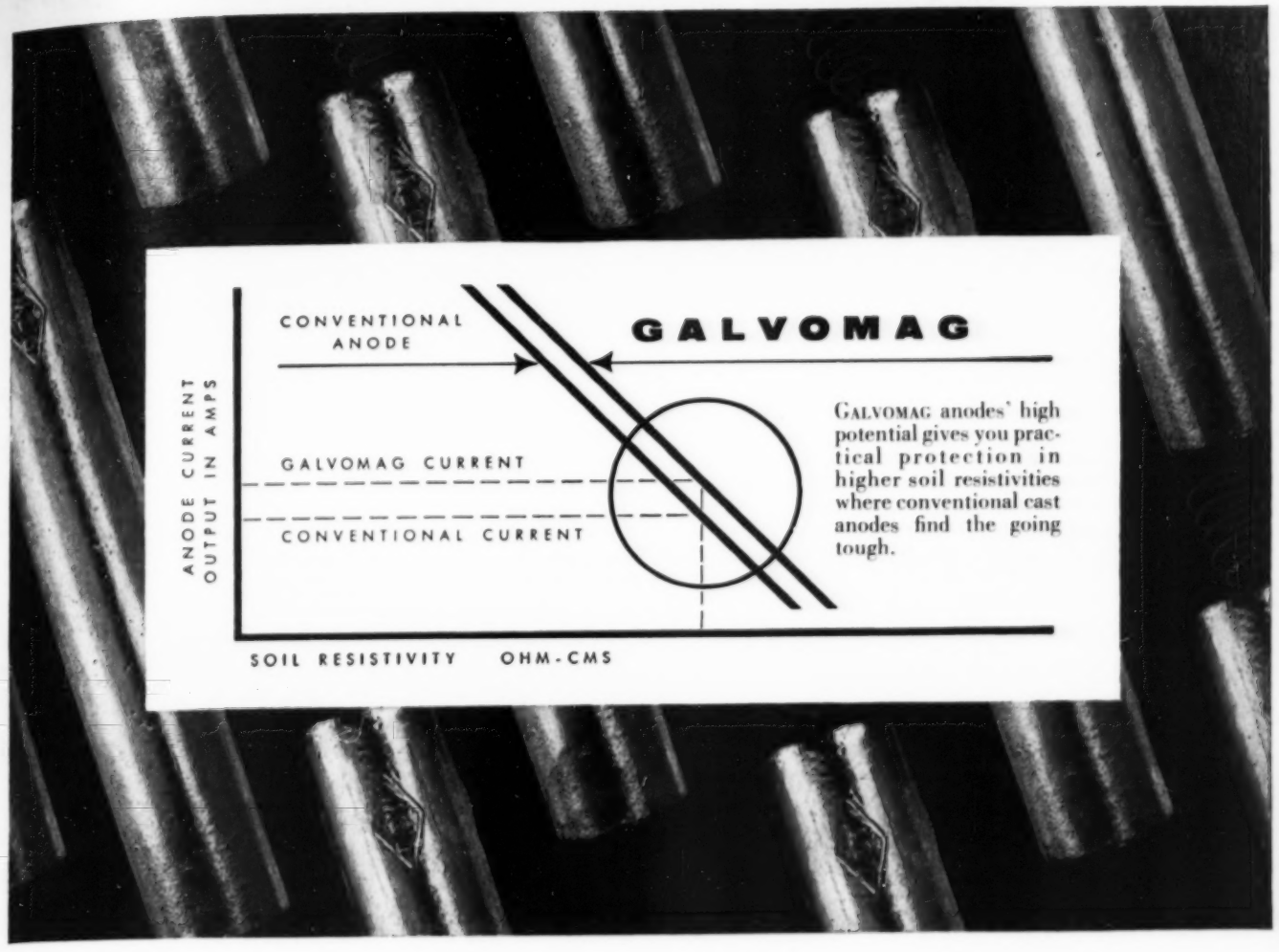
Houston firm to build 961-mile line to Florida

Houston Texas Gas & Oil Corp. of Houston has filed with the FPC an application for authority to build and operate a $110.4 million, 961-mile gas pipeline from Louisiana to deliver natural gas to the principal markets in the state of Florida.

The applicant proposes to transport an average daily quantity of 350 MMcf/day. A major part of the mainline will be 30-in. so that additional requirements of the markets of Florida can be provided in the future.

The project would provide for the first time natural gas in sufficient quantities for general service of natural gas throughout the state of Florida. Florida, one of the fastest growing of the 48 states, is the only remaining major market area in the United States that is not being served with natural gas or for which such service has not been authorized.

The line will consist of approximately 500 miles of 30-in. pipe, 156 miles of 26-in., 60 miles of 20-in., 224 miles of 18-in., and 12 miles of 12¾-in. pipe, extending from a point near Baton Rouge, La., to a terminus near the city of Miami, Fla. It will also have four mainline compressor stations and approximately 500 miles of lateral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pipeline in the state of Florida is proposed.

Gas is to be sold by the pipeline under contracts with the markets to be served. It is proposed initially to serve 28 market areas, which in turn serve a total of 57 cities and towns in Florida. Included are 16 gas utility systems with gas distributing facilities and 25 cities and towns which do not have any gas utility service at present. Service to these cities and towns and those in which a gas distributing system already exists will bring to 82 the total of cities and towns expected to receive natural gas for the first time. The pipeline also proposes to deliver substantial additional quantities of such gas pursuant to contracts with various industrial customers in Florida.

Houston Texas Gas & Oil Corp. has entered into a 20-year gas service agreement with Coastal Transmission Corp., also of Houston, Texas, by the terms of which agreement Coastal will deliver to the proposed Florida pipeline at its point of origin an average of 350 MMcf/day. The Florida line may take, if its markets require, up to 385 MMcf of such gas per day, and may over a period of two years after the commencement of operation increase such daily maximum to 440 MMcf/day. Coastal Transmission proposes to file its separate application with the FPC in the near future for authority to transport and sell to the Florida line the gas required initially by the Florida market.

The directors and officers of Houston Texas Gas are: F. E. Stanley, chairman and president, Tulsa; Eugene Bashore, New York City; C. C. Barnard, vice president, Baton Rouge; Mrs. H. S. Mack, treasurer, O. Paul Herzig, vice president, engineering and construction, and Allen R. Kleinkauf, all of Houston; James Roddy, New Orleans; John M. Harbert III, Birmingham; and Paul C. Wallack, vice president, and Theodore Rinehart, general counsel and secretary, both of Tulsa.

Investment banking firms counseling the proposed pipeline on financing are Blyth & Co. Inc. of New York City, and Scharff and Jones Inc. of New Orleans.

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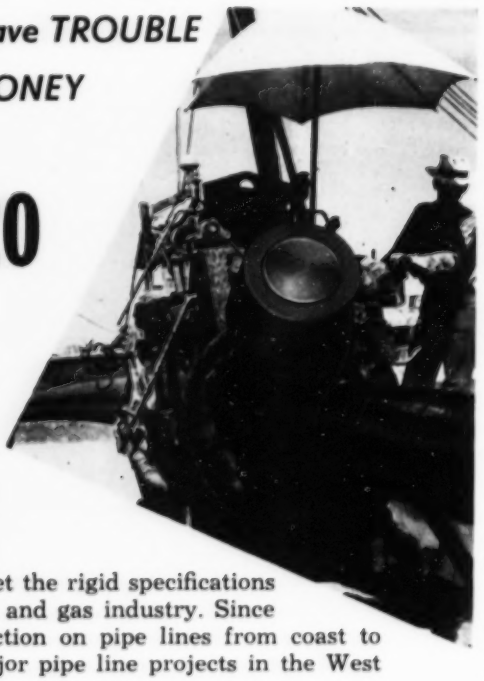

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SHREVEPORT, LOUISIANA

Pouring-weight service launched by Allan Edwards

Allan Edwards Inc., Tulsa, has inaugurated a service of pouring weights at strategic points along the pipeline right-of-way whenever sufficient tonnage is involved.

The company recently set up pouring operations for United Gas at Purvis, Miss., Milton, Fla., and Saraland, Ala., completing the job three weeks ahead of schedule.

Similar jobs have been completed recently for Cities Service and Panhandle Eastern. Another job is underway for Colorado Interstate at Greeley, Colo.

Small quantities and tonnage of river weights will still be made at the Tulsa plant.

Officials confer on TransCanada project

Prospects of the completion of the gas pipeline (see GAS, September, p. 8) between Alberta and eastern Canada by 1957 appeared brighter last month after a conference of Canadian government and pipeline officials.

Predictions are that the troublesome link across northern Ontario would be built by a government-supported body and leased to TransCanada Pipe Lines Ltd. Prime Minister Louis St. Laurent is hopeful that construction will commence next year.

Additional information indicated that by late 1956, TransCanada would have completed a line from Toronto to Montreal to serve the Quebec city with gas bought in the East from Tennessee

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Gas Transmission Co. in return for what TGT gets in the West. The "all-Canadian" pipeline, taking off from Winnipeg would reach Toronto in the fall of 1957, at which time TransCanada would shut off imports of American gas in the East and feed the Ontario-Quebec market with Alberta fuel.

Northern Natural plans $32 million project

Northern Natural Gas Co. plans to spend $32 million to construct facilities for natural gas service in 1956 to 55 communities in Iowa, Minnesota, South Dakota, and Wisconsin, including extensions from the Twin Cities to Duluth, Minn. and Superior, Wis., from Sioux Falls, S. D., to Aberdeen, S. D., and from Rochester to Winona, Minn. This application filed recently with the FPC supplements one filed earlier proposing to build the Duluth and Aberdeen extensions this year and serve them with natural gas from Canada. John Merriam, president of Northern, says that because of the confusion in the Canadian natural gas picture, it is very doubtful that a Canadian supply will be imported until 1957 at the earliest.

Gas for Northern's 1956 proposed program would come from its present sources of supply in the southwestern United States plus additional supplies which are purchased throughout the year under normal procedure of building up reserves.

Construction costs will be reduced substantially by the proposed use of underground storage near Redfield, Ia. Northern believes the underground storage will add approximately 50 MMcf per day to the company's daily capacity during the 1956-1957 heating season.

The 1956 construction program would enable Northern to increase its daily capacity approximately 93 MMcf. The company's present daily capacity is 1.1 billion cu ft. Presently connected communities would receive approximately 37 MMcf daily of the capacity. Northern also seeks to serve 12 MMcf daily to the Allied Chemical & Dye Corp. plant near Omaha.

The construction would include 15 miles of 24-in. pipe to its mainline in Nebraska; approximately 28 miles of 24-in. pipe from Ogden, Ia. to the underground storage near Redfield, Ia.; 168 miles of 20-in. line from the Twin City area to Duluth and Superior; 92 miles of 12-in. line and 71 miles of 10-in. line in South Dakota and 307 miles of branch lines. Horsepower to be added to compressor stations in Texas, Kansas, Nebraska, and Iowa would total 12,640.

Two 16" 300-lb. Commercial Type CN Orifice Fittings on transmission lines in gas booster station, Refugio, Texas

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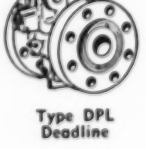

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CANADA: Peacock Bros., Ltd., Montreal, Quebec

In laying a new 24-in. gas line across northern Pennsylvania, Oklahoma Pipeline Contractors of Dallas, contractors for Tennessee Gas Transmission Co., found it necessary to trench through material that varied from sharp rock to flooded mud. Evidence of the material is shown in this picture made near Honesdale, Pa., showing a Bucyrus-Erie dragshovel at work. The machine is digging a 42-in. wide trench to an average depth of 5 ft, working 10 hours daily, seven days a week.

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PSC says cost of local not import gas proper rate base

West Virginia's PSC authorized United Fuel Gas Co. to increase its rates in the state by $565,283 annually. The company had sought increases to yield $2,383,000 in additional annual revenue.

In asking for the higher amount, the company took the view that West Virginia customers should share the burden of paying the costs of transmitting gas from the Southwest. The commission held, however, that rates for intrastate business should be "based upon the costs of gas produced in West Virginia and consumed here rather than upon the costs of Southwest gas which is produced elsewhere and consumed elsewhere."

The PSC pointed out that when the company first acquired the principal units of its distribution system more than 40 years ago, "it also acquired the gas production properties which constituted their source of supply.

"The volume of local gas produced or purchased by the applicant is now about twice the volume of the applicant's retail sales in West Virginia and constitutes its principal source of supply," the commission said.

"In recent years the applicant has seen fit to substitute for a small quantity of this local supply a corresponding quantity of Southwest gas purchased from the Tennessee Gas Transmission Co., but the evidence indicates that at least 90% of all the gas sold by the applicant in its West Virginia-regulated business still is local gas produced or purchased by the applicant here in the area where it is consumed."

At another point in its decision, the commission said: "A customer who is supplied with gas produced in his own back yard ought not be charged rates upon the cost of gas being transmitted through his front yard from the Texas fields eastward to Washington, Baltimore and the state of New York.

"Neither should he be penalized because the applicant chooses to use West Virginia as a mixing station for Southwest gas and local gas in order to supply the markets of the Columbia Gas System elsewhere."

The PSC rejected the utility's contention that basing the rates only on local production and consumption would be unconstitutional.

If the utility sees fit to export West Virginia gas and import other gas to serve local markets, then that's a matter of "managerial discretion," the commission said.

The PSC arrived at the decision to grant the rate increase after studying profit and cost estimates prepared by the company and the commission's staff and consultants. The new rates are calculated to bring the company a 6¼% return on its investment.

Gas sales reached 7.74 trillion cu ft in 1954

Operating revenues of natural gas companies filing annual reports with the FPC totaled $2,274,183,000 for the year 1954, and sales of natural gas by the companies amounted to 7.74 trillion cu ft. Passage of the Hinshaw Amendment to the Natural Gas Act, H. R. 5976, reduced the number of natural gas companies reporting to the commission from 160 in 1953 to 115 in 1954.

Sales of natural gas and revenues from such sales reported by the natural gas pipeline companies for 1954 amounted to 6.23 trillion cu ft and $1,532,030,000, respectively, representing increases of 8.0% in sales and 13.7% in revenues, over sales of 5.77 trillion cu ft and revenues of $1,347,194,000 in 1953. In keeping with the character of the companies, 80% of

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noise energy eliminated in Gas Regulation

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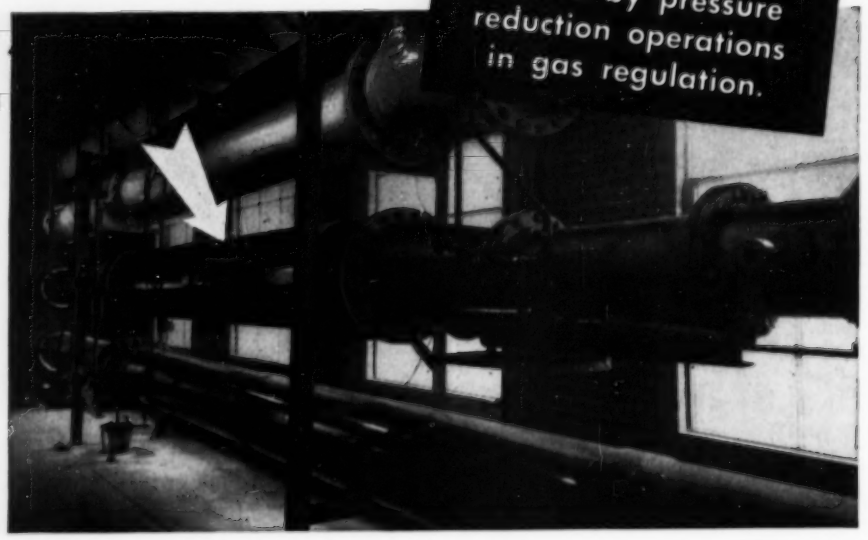

The PRS Silencer in the photograph is installed in the gas regulator system of the gas mixing plant at the Lehigh Valley Gas Division, United Gas Improvement Company, Bethlehem, Pennsylvania. This regulator reduces natural gas pressures from 45 psig. to approximately 2 psig. Sound Surveys at this installation prove the PRS Silencer—

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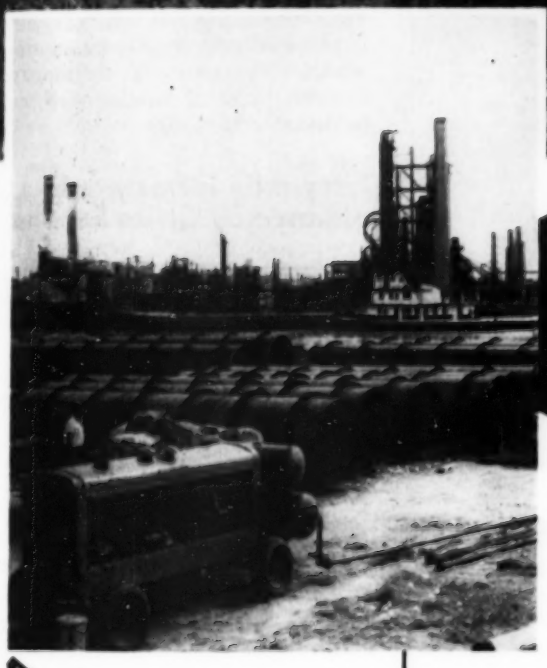

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their 1954 gas sales, 4.98 trillion cu ft, were made to other natural gas companies for resale. Revenues from such sales, $1,282,437,000, were equal to 83.7% of total revenues from all gas sales. Total gas operating revenues of the companies, including revenues from sales of products extracted from natural gas, "other natural gas revenues" and a relatively small amount of revenue from manufactured gas operations, totaled $1,597,090,000 during 1954, an increase of 13.4% over the $1,407,638,000 received in 1953.

Gas operating revenue deductions, including charges for operations and maintenance and provision for depreciation and taxes, amounted to $1,344,127,000 for the year and in relation to revenues remained unchanged from 1953 at 84.1 cents per revenue dollar. During 1954, 64.5 cents of the revenue dollar went for operating expenses, including the cost of purchased gas, 9.7 cents for depreciation, 6.9 cents for Federal taxes on income including 0.5 cent provision for deferred taxes, and 3.1 cents for other Federal, and state and local taxes.

Gas utility operating income for 1954 amounted to $253,173,000 and was equivalent to 6.1% of the average net gas investment for the year. For 1953 gas utility operating income was $222,469,000 and the comparable rate 6.0%.

Gross income of the companies, including $12,884,000 non-operating income, amounted to $266,057,000 for 1954. Income deductions aggregated $99,894,000 for the year. Interest on long-term debt, amounted to $92,469,000 for the year, was earned 2.9 times.

Net income of the companies for 1954 amounted to $166,163,000 representing an increase of 7.4% over the $154,645,0000 reported for 1953.

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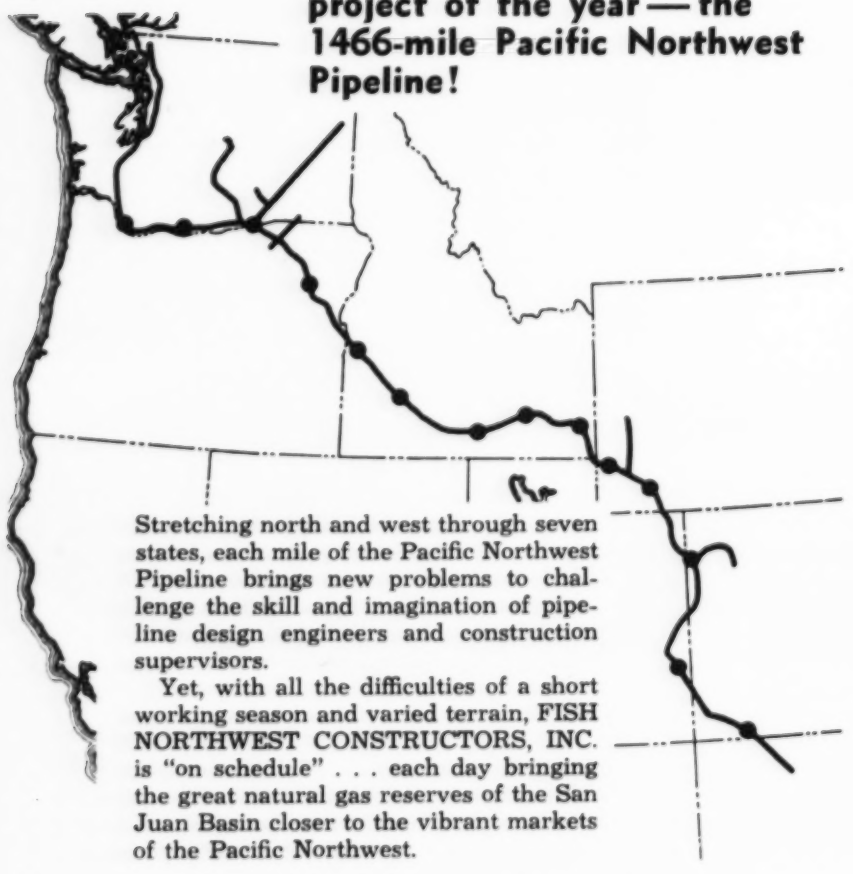

Stretching north and west through seven states, each mile of the Pacific Northwest Pipeline brings new problems to challenge the skill and imagination of pipeline design engineers and construction supervisors.

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FPC denies Northern plan to serve power station

A proposal by Northern Natural Gas Co., Omaha, to build pipeline facilities to supply natural gas on an interruptible basis to the Black Dog power generating station of Northern States Power Co. has been denied in a decision filed by an FPC presiding examiner (Docket G-2409).

Presiding Examiner Francis L. Hall ruled that Northern has not shown that the proposed facilities "are required by public convenience and necessity."

Northern is proposing to build 1.42 miles of 16-in. branch line, with a capacity of over 100 MMcf of gas per day, and a measuring and regulating station in order to serve the Black Dog station, which is located south of Minneapolis. Estimated cost of Northern's proposed facilities is $131,000.

Fifty-mile intrastate line planned by Cities Service

Cities Service Gas Co. will operate a 50-mile, 16-in. intrastate line to carry gas from the Spivey field in Kingman county, Kan. to Kansas Gas & Electric Co.'s Murray Gill plant near Wichita.

The line, which will be built by Kansas Gas Supply Corp., a newly formed company organized by Empire Gas & Fuel Corp., while primarily serving Kansas Gas, the capacity displaced from Cities Services' existing facilities will be made available to customers throughout the system.

Annual requirements of the Murray Gill plant are about 10 billion cu ft of gas.

El Paso construction approved by FPC

El Paso (Texas) Natural Gas Co. has been granted temporary authority to construct and operate natural gas facilities estimated to cost $2,225,000

which would enable El Paso to purchase approximately 60 MMcf of residue natural gas per day from the Texas Hydrocarbon Co.

Concurrent with the El Paso authorization, the FPC granted Texas Hydrocarbon authority to deliver and sell the gas to El Paso.

El Paso's construction would include approximately 61.6 miles of 14-in. pipeline extending from the Texas Hydrocarbon Jameson plant, Coke county, Texas, to El Paso's Tex-Harvey compressor station, Midland county, Texas; an additional 880-hp compressor unit with necessary appurtenances at the Tex-Harvey station; and a purchase meter and check meter stations.

GAS pipeline notes

Ground has been broken for a $3 million gas fractionation plant at Newcastle, Wyo. Wet gas not being flared in the Clareton field will be gathered and taken to compression facilities in the field to extract the liquid hydrocarbons, which will then go to Newcastle for processing.

Grading of the right-of-way for the 31.5-mile loop section of Southern California and Southern Counties Gas Co.'s Texas-to-California line got underway last month. The new line, which will complete paralleling of the 210-mile California portion of the line providing two completely separate gas arteries, extends roughly from a point east of Desert Center to east of Cactus City.

Darling-Kenady Co. has been appointed Denver representative for the C. Lee Cook Co., Louisville, Ky. The Darling - Kenady organization, with headquarters in the Mining Exchange building, is headed by R. A. Darling and Phil Kenady.

Montana Power Co., Butte, has been granted a five-year permit to export natural gas from Alberta by the Canadian government. The utility had asked for a 20-year permit. The gas will be used for service to general customers specifically in the Missoula area.

The 1955 revision of FPC's map of "Major Natural Gas Pipe Lines" in the United States has been issued. The five color map shows major existing pipelines, those under construction, those which have been authorized and not yet started, and proposed lines which are pending commission action. Existing or proposed pipeline systems of 115 companies are represented. In addition to pipelines, the map shows the location of natural gas fields, indicating both major sources and generalized areas of supply. Copies of this map may

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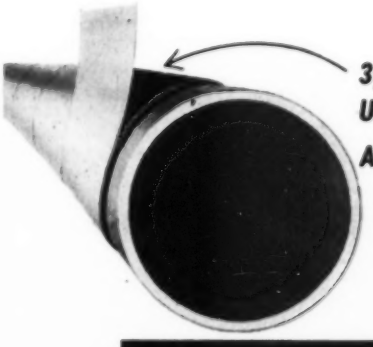

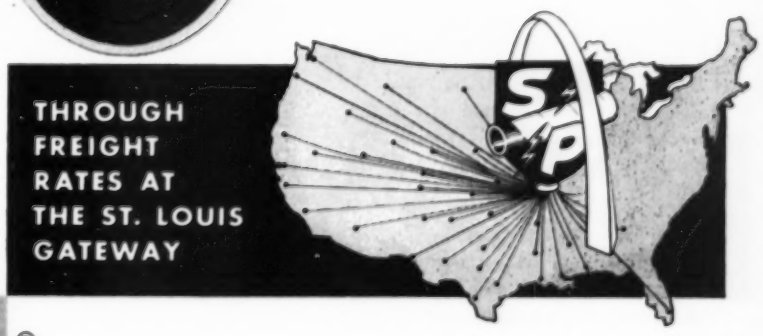

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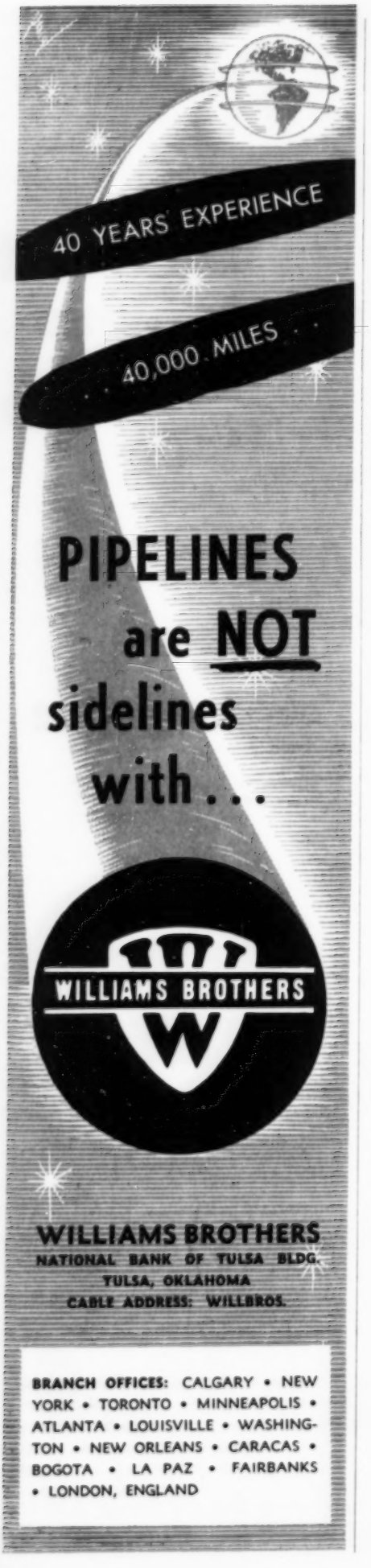
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pipeline news • *Cont'd.*

be purchased from the FPC, Washington 25, D. C., at 25 cents each. Order number is FPC M-44.

Southern Natural Gas Co., Birmingham, has received temporary authorization from the FPC to construct natural gas facilities estimated to cost $2,020,518. Included in the construction are approximately 24.7 miles of pipeline intended to increase the delivery capacity of branch or lateral lines and including replacement of 5.5 miles of pipeline near Atlanta, Ga.; the addition of 4950 hp in two existing compressor stations and construction of approximately 16.2 miles of pipeline; and 7.5 miles of pipeline to connect existing facilities with a new gas supply from Patterson Field, St. Mary Parish, La.

A decision, subject to commission review, has been filed, authorizing Tide Water Associated Oil Co., Houston, an independent producer, to sell natural gas for resale in interstate commerce to Texas Illinois Gas Pipeline Co., United Gas Pipe Line Co., Iroquois Gas Corp., Texas Eastern Transmission Co., El Paso Natural Gas Co., Transcontinental Gas Pipe Line Corp., Tennessee Gas Transmission Co., and Arkansas Louisiana Gas Co.

GAS progress reports

NEW CONSTRUCTION PLANNED

KANSAS GAS SUPPLY CORP. To build a 50-mile 16-in. line from Spivey field in Kingman county, Kan. to Kansas Gas & Electric Co.'s Murray Gill plant near Wichita.

CURRENT CONSTRUCTION

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

ATLANTIC SEABOARD CORP., Charleston, W. Va. Docket G-6500 for 84-mile, 26-in. line paralleling Cobb (W. Va.)-Baltimore (Md.) line in West Virginia, Virginia, and Maryland, and 2000 additional hp at Cleveland station in Upshur county, W. Va. Williams-Austin Co. working on 31 miles in Brafton, Upshur and Randolph counties, W. Va.

CITIES SERVICE GAS CO., Oklahoma City. Docket G-8571 and 8572 to install 39 miles of replacement line in Newton, Lawrence, Lafayette, and Johnson counties, Mo., and Johnson county, Kan.

COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2121 - (1955 program) 385 miles of 22-in. line from Denver to connection with proposed Pacific Northwest Pipeline Corp. line at Green River, Wyo.; with 4400-hp compressor station near Green River. Houston Contracting Co. began construction June 15; 40 miles complete 8/1/55. Balance, 11/1/55.

MICHIGAN GAS STORAGE CO., Jackson. Docket G-6501 for 36-mile 16-in. line and 3300 hp addition at Freedom compressor station in Michigan. Line would extend from Mt. Pleasant Junction to Milwaukee Junction. Work on compressor started May 16. Bechtel Corp. to start July 1 on line.

NEW YORK STATE NATURAL GAS CORP., Pittsburgh. Docket G-8568 for 21 miles of 20-in. line paralleling section of line in Wyoming and Livingston counties, N. Y. to complete looping of line from Potter county, Pa. to near Caledonia N. Y. Potter-DeWitt Corp. now at work.

OHIO FUEL GAS CO., Columbus. Docket G-8752 for 19 miles of line and a new metering station in north Central Ohio. Ohio Pipe Line Construction Co. 25% finished with job.

PACIFIC NORTHWEST PIPELINE CORP., Houston. Docket G-1429 for 1466 miles mainline; 443 miles of spur and lateral lines; and 14 mainline compressor stations totaling 81,120 hp and 2 booster stations totaling 3300 hp, to extend from Ignacio, Colo., in the San Juan basin, to Bellingham, Wash. (Seattle area). Fish Northwest Constructors Inc., builders of the line, have let contracts to River Construction Corp., R. H. Fulton & Co., Associated Pipeline Contractors, A. J. Curtis Construction Co., B. & M. Construction Co., Midwestern Constructors Inc., H. B. Zachry Co. and Fulghum Construction Co. for first 655 miles.

PANHANDLE EASTERN PIPE LINE CO., Kansas City, Mo. Docket G-2433 for construction of 294.5 miles of mainline loops, 106.3 miles of lateral loops, and 4750 additional hp. The 294.5 miles located in Kansas, Missouri, Illinois, Indiana, and Ohio were constructed in 1954 and are being operated under a temporary FPC permit. Remainder of work is being held in abeyance until approved by FPC.

SOUTHERN COUNTIES GAS CO., Los Angeles. To build 31.5 miles of 30-in. line between Cactus City and Desert Center in Riverside county, Calif., to complete paralleling of the California-Texas pipeline system.

TENNESSEE GAS TRANSMISSION CO., Houston. Dockets G-2310, G-2330 and G-2331. Construction is well advanced in Pennsylvania, New Jersey, and New York on a 250-mile, 24-in. line from Hebron (Pa.) storage field to Greenwich, Conn., and an 18-mile 24-in. Hebron to Harrison storage field plus 36 miles of 26-in. loop in Ohio have been completed. Development of two more storage fields—Colden near Buffalo; Harrison, in Potter county, Pa. Construction is underway at Isola, Miss., and at Morehead, Ky., on new compressor stations. This fall company will construct 370-mile, 30-in. line from Agua Dulce, Texas, to Kinder, La., along Texas and Louisiana Gulf Coast line (Docket G-8215).

TEXAS EASTERN TRANSMISSION CORP., Shreveport, and **NEW YORK STATE NATURAL GAS CORP.**, Pittsburgh. Docket G-2784 to construct field pipelines to connect up additional wells in Murrysville pool; acquire 2000-hp field gathering compressor station; and install 1980-hp station. New York State will operate facilities.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2503 for 477 miles of line, 91,400 hp in new compressor stations, and 36,020 hp additions at existing stations—all to be located in Texas, Louisiana, Mississippi, Tennessee, Kentucky, Ohio, Pennsylvania, and Alabama. Project would include a 377-mile line from Beaumont, Texas, to Kosciusko, Miss. The following contracts have been let: Houston Contracting Co., 59 miles; Tulsa Williams Co., 118 miles; H. C. Price Co., 134 miles; H. B. Zachry Co., 64 miles. Brown & Root Inc. will construct the compressor stations and furnish field supervision. Pipeline construction under way; compressor work starting.

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky. Docket G-6854 to lay 77.14 miles of partial loops in 7 sections between Covington, Tenn. to Jeffersontown, Ky.; 74 miles, 12-in., 35 miles 10-in., and 5 miles, 8-in. between Hardinsburg, Ky. compressor station and Columbus and Belford, Ind.; to construct 26-in. crossings of Ten-

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PACIFIC NORTHWEST PIPELINE CORPORATION

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nessee and Cumberland rivers in Kentucky and dual 12-in. crossings of Ohio river near Hardinsburg, Ky.; to build 4500-hp station at Columbia, La., and to add 4000 hp at Greenville and Clarksburg, Miss.; 2000 hp at Lake Cormorant, Miss., and 1500 hp at Covington, Tenn. H. C. Price Co. to lay 26-, 12-, 10-, and 8-in. lines (except river crossings); Houston Contracting Co. to lay 20-in.; Pentzein Inc. to lay Cumberland, Tennessee and Ohio river crossings. Completion set for Oct. 31, 1955.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-4185 for 360 miles of 36- and 30-in. line paralleling sections of system in nine states. Would include two river crossings; one 3000-hp and one 7500-hp station and miscellaneous additions to present stations. Contracts let to O. R. Burden Construction Corp., Associated Pipe Line Contractors Inc., Midwestern Constructors Inc., Houston Contracting Co., Western Constructors, Panama-Williams Co.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-2367 for 173 miles of 30- and 36-in. loops to parallel sections of existing system in Louisiana, Mississippi, Alabama, Georgia, North and South Carolina, Virginia, and Maryland, plus 46 miles of 12-in. and 16-in. loops and 12-mile, 24-in. extension of mainline in New Jersey. Contracts let to O. R. Burden Construction Corp., Midwestern Constructors Inc., Panama-Williams Co., Williams Brothers Co., and Associated Pipe Line Contractors Inc.

APPROVED

UNITED GAS PIPE LINE CO., Shreveport. Docket G-8230 for 63 miles of line and 330-hp station on system in Mississippi, Alabama, and Florida. Would drill 13 wells, build 7.3 miles of line, a dehydration plant, and additions to compressor stations for underground storage.

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GAS pipeline people

The following promotions have been announced by Texas Gas Transmission Corp., Owensboro, Ky.: WILLIARD O. LAPE, director of employee relations; R. W. MATTINGLY, manager of the safety and training department; LOUIS E. FLOYD, manager of the Columbia, La., compressor station; JOE RUSSELL, manager of the Haughton, La. station; and JAMES G. ELLIOTT, division superintendent of the land and lease department.

RICHARD S. BRENT has been appointed district sales engineer, Chicago district office of J. F. Pritchard & Co. of California, Kansas City, Mo.

Motorola Inc. has made three personell appoints for its transistor manufacturing facility in Phoenix: JOHN T. HICKEY is general manager, DR. VIRGIL E. BOTTOM is director of research and development, and EDMUND G. SHOWER is product production manager.

R. E. ROGERS, formerly manager of the Los Angeles branch of the Foxboro (Mass.) Co., has been named manager of the company's West Coast sales activities. Succeeding him as Los Angeles manager is E. W. PITT, who is succeeded as branch manager in Shreveport by D. P. THOMAS. Other new appointments include: M. F. PARR, regional engineer at San Leandro, Calif.; C. E. HEEGARD, industrial engineer at Los Angeles; and C. J. DE VILBISS, industrial engineer at Shreveport.

BRUCE W. GRUBE has been named director of management development and training at Kaiser Steel Corp.

Logistics Research Inc., Redondo Beach, Calif., has appointed W. V. NEISIUS, formerly director of applications, to the post of vice president, application and sales. A. Y. BAKER, formerly chief engineer, is now vice president, development and production.

W. V. Neisius

A. Y. Baker

Logistics Research

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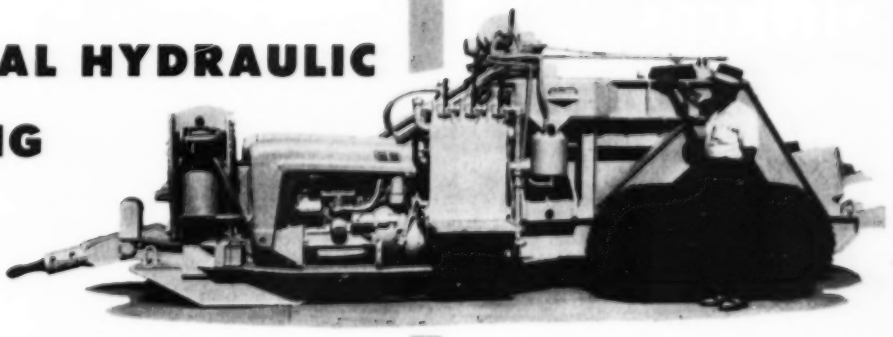

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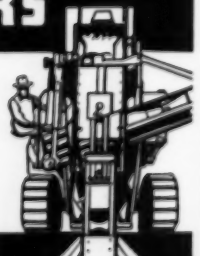

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Tulsa, Oklahoma

pipeline people • *Cont'd.*

Automatic Electric Sales Corp. has appointed JACK B. ARNOLD as division manager of railroad and industrial sales, carrier-radio group. He succeeds TATE B. COLLINS JR., who has been named division manager for independent telephone company carrier and radio sales.

J. B. Arnold
Automatic Elec.

M. A. Ellsworth
Fluor

Engineering and construction operations of the Fluor Corp. Ltd., Los Angeles, are being combined into one division under the direction of M. A. ELLSWORTH, who will serve as vice president and general manager.

L.O.F. Glass Fibers Co., Toledo, has announced the following appointments: H. MATTHEWS BOWERS is now general quality control manager; CALVIN A. CALENDINE succeeds him as quality control manager of the Parkersburg plant; and NED P. KIMBERLY is now district manager in Cleveland.

HOWARD C. BARTEN has been named manager of Worthington Corp.'s gas tranmission section of the engine sales division.

Lone Star Gas Co.'s pipeline department has announced four promotions. J. N. CARPENTER is now superintendent of the department; HERMAN DEMPSEY is assistant superintendent with headquarters in Dallas; EARL MILLER succeeds him as foreman of the Fort Worth pipeline district. In turn, MARVIN STORY, formerly construction supervisor, succeeds Mr. Miller as construction foreman in charge of the No. 1 construction crew. The changes were brought about by the retirement of LUTHER TOLBERT, who has headed the department since 1948.

C. D. ATTAWAY, formerly with the Arkansas Louisiana Gas Co., has joined the Michigan-Wisconsin Pipeline Co. as director of safety.

W. H. KRAEMER has been appointed to the Los Angeles branch office of the Cooper-Bessemer Corp., Mt. Vernon, Ohio.

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- ★ Nicolet "Tufbestos" 8 lb. *Asbestos* Felt reinforced with parallel glass yarns, Tar or Asphalt Saturated
- ★ Nicolet "Reflecto" 8 lb. or 10 lb. White Neoprene Treated *Asbestos* Felt, glass yarn reinforced

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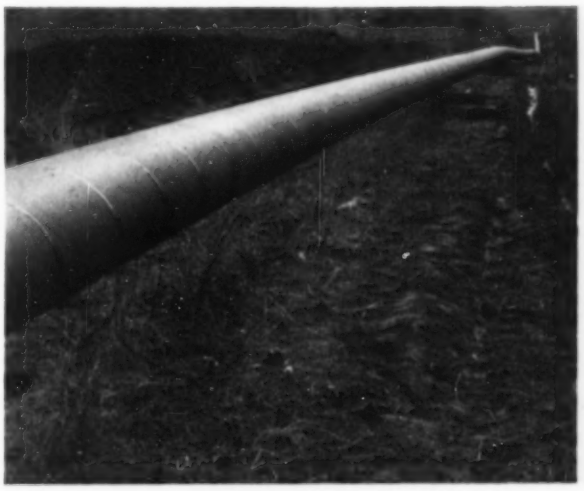

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